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Сэтгүүлд бусдын бүтээл, бүтээлийн хэсэг болон санааг хуулбарлаагүй, анхдагч үр дүнтэй, ашиг сонирхлын зөрчилгүй, үнэн зөв хийгдсэн бүтээлийг хэвлэнэ.

Evaluation of the Program for Supporting Food and Agriculture Production using Policy Costing Simulation

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Abstract

Although the Government of Mongolia implements numerous policies and initiatives, comprehensive methodologies and full assessments of their medium- to long-term implications for the state budget and the economy are not always publicly available. Building on a semi-structural GAP model, this study applies a policy costing methodology to estimate the budgetary and economic effects of the government-implemented subsidized loan program in 2023 to support the production of food and agricultural products. The Mongolia Macro-Fiscal Model by NRGI (2017), extended and updated with data through the third quarter of 2023, was used to simulate the program as an exogenous shock and to compare the resulting paths with a baseline projection. The exercise is an ex-ante policy-costing simulation rather than an empirically identified impact evaluation; the reported magnitudes are therefore model-implied effects that hold under the stated assumptions. The results indicate that, compared to the baseline projections, the program is expected to have a tangible positive effect on the economy in the medium term. Relative to the baseline projections, the simulations suggest that the program is associated with a positive contribution to economic activity over the medium term. By applying a policy-costing approach to a government program in Mongolia, this study represents an initial attempt that may serve as a useful starting point for similar analyses.

Keywords: Policy costing, GAP semi-structural model, subsidized loan program, Mongolia

JEL Classification: E17, E62, H50, O23, Q18

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This paper presents an academic adaptation of the findings from the report "Pilot Findings from the Policy Costing Methodological Guide: Evaluation of the Program for Supporting Food and Agriculture Production", prepared as part of the consulting service "Developing a Methodological Guide for Policy Costing and Piloting It in Selected Programs", commissioned by the Secretariat of the Parliament, the Ministry of Economic Development, and the United Nations Development Programme. The report was developed within the EU-funded project "SDG-Aligned Budgeting to Transform Employment in Mongolia", implemented by UNDP, FAO, and ILO. The report can be found at https://sdgbeproject.mn/public/storage/media/2c4b6145-d9c1-4442-827f-10ac56ed2c79.pdf.

1 Introduction

Policies and measures implemented by governments can have both intended and unintended effects on the state budget and, more broadly, on the macroeconomy. Therefore, it is essential to assess the economic impact of any policy or intervention that may have significant effects prior to its implementation. One key approach used for this purpose is policy costing. Policy costing is the process of estimating the financial and economic impacts of specific government policies, programs, or initiatives. More specifically, it involves calculating the medium-term fiscal costs (following international practice, for example, up to 5 years in the UK) of a given policy measure and analyzing the resulting fiscal burden by comparing economic conditions before and after its implementation.

The application of policy costing enables policymakers to systematically and transparently assess the fiscal implications of various measures, including taxes, fees, social welfare programs, subsidies, transfers, expenditure policies, and other interventions. It provides a standardized framework for clearly and concisely expressing the resulting fiscal burden, tax pressure, and public expenditure impacts. This, in turn, facilitates informed debate, comparison of policy alternatives, and evidence-based policy planning.

At present, policy costing methodologies and systems are widely regarded as international best practice for fiscal analysis and policy evaluation. In recent years, significant efforts have been made globally to institutionalize and formalize this process. According to the International Monetary Fund (2021), 51 countries currently have independent institutions that estimate and monitor fiscal costs using similar methodologies[4].

Moreover, many countries have established independent institutions under their parliaments or governments to conduct fiscal analysis and support decision-making. According to the OECD (2021), 32 out of 36 member countries have some form of independent fiscal institution. Notable examples include the United Kingdom and Canada. In the United Kingdom, policy costing and evaluation are conducted primarily through institutions such as the Treasury and the Office for Budget Responsibility (OBR), which use macroeconomic models to estimate both direct and broader economic impacts of policy measures, particularly for annual budgets and major initiatives. These assessments are central to budget formulation and to ensuring fiscal responsibility, and are refined through comparison with other analyses. The underlying models and methodologies are publicly available (OBR, 2013; 2024), allowing external scrutiny and enhancing transparency and credibility. Similarly, Canada's Parliamentary Budget Officer (PBO) independently evaluates the financial and economic implications of proposed policies and budgetary measures. The analysis often incorporates a wide range of research to consider long-term risks, and different methodologies are applied depending on the nature of the policy sector and available data. Detailed methodological documentation is provided to ensure the

[4] As of May 2024, the International Monetary Fund's Fiscal Council Dataset includes information on independent fiscal councils from 51 countries (https://www.imf.org/en/Data/Fiscal/fiscal-council-dataset). The longest-standing councils are the Netherlands' Bureau for Economic Policy Analysis, established in 1945, and the U.S. Congressional Budget Office, established in 1974. Following the global financial crisis, the number of independent fiscal councils increased sharply, and membership in such institutions became a requirement for countries in the Euro area. In recent years, emerging economies such as Chile, Uruguay, and Costa Rica have also begun establishing their own fiscal councils.

quality and transparency of the analysis, while key modeling and assumption choices are made independently, drawing on both institutional expertise and external input (PBO, 2024).

In Mongolia, budgetary expenditures and public investment have increased substantially over the past 20 years, and social spending, investment, welfare, and transfer expenditures have reached very high levels. However, evaluation and oversight of their effectiveness have not been conducted in a consistent and scientifically grounded manner at either the parliamentary or government level, resulting in a significant gap in the analysis of budget expenditures and the effectiveness of associated policy-related spending. This highlights the need for a unified and systematic approach to policy evaluation, including consistent estimation of fiscal impacts and comparative analysis of conditions before and after policy implementation.

This study aims to ex-ante evaluate the policy cost of the resolution adopted by the Parliament of Mongolia in 2022, titled "On Certain Measures to Ensure Food Supply and Security", using a policy costing methodology. In particular, the analysis focuses on the subsidized loan program implemented by the Ministry of Food, Agriculture, and Light Industry (MOFALI) under this resolution, which is designed to support food and agricultural production.

Agriculture and food processing are strategically pivotal for Mongolia's economic stability, resilience, structural diversification, food security, and employment. In 2023, agriculture contributed 9.8% and manufacturing 7.3% of GDP, with food and beverage production accounting for 15.4% of manufacturing output. Despite their economic importance, these sectors account for only a small share of active enterprises, at 3.5% and 2.2%, respectively. They also employ a substantial portion of the workforce, with nearly 361.8 thousand people in agriculture and 108.8 thousand people in food processing, underscoring their role in sustaining livelihoods and rural communities. Supporting these sectors simultaneously advances multiple policy objectives: reducing reliance on the mining sector, strengthening domestic supply chains, and promoting export-oriented production. Subsidized loans, therefore, provide focused support that helps maintain sector activity, encourages incremental growth in production and supply, and reinforces broader economic and social priorities.

Compared to the baseline scenario, the simulations suggest that, under the model's assumptions, the subsidized loan program is associated with a positive contribution to real GDP, its components, inflation, employment, and nominal wages. However, these effects are projected to begin diminishing from the third year onward.

This study contributes to the literature by applying a policy costing methodology to evaluate a government program in Mongolia, thereby offering an initial application that may inform similar analyses. One limitation of the study is that the model used aggregates GDP into three sectors, namely agriculture, mining, and other sectors, which makes it difficult to directly estimate the program's impact on employment and nominal wage growth in the food sector. Future research could improve on this by further refining the model to enable more detailed sectoral analysis.

The remainder of the study is structured as follows. Section 2 presents the literature review. Section 3 describes the subsidized loan program, the macroeconomic model, and the data.

Section 4 presents the findings. The appendix provides details of the additional survey conducted to obtain information required for the model.

2 Literature review

A central task in policy analysis is to compare alternative policy scenarios and evaluate whether government interventions achieve their intended objectives. Macroeconomic models serve as a key tool in fulfilling this purpose. In addition to fully structural DSGE models, semi-structural models have gained increasing popularity over the past two decades (Simona & Stanislav, 2025). Specifically, modern policy analysis increasingly relies on semi-structural macroeconomic models to evaluate the dynamic effects of fiscal interventions. These models, widely used by central banks and international institutions, combine theoretical rigor with empirical flexibility, making them particularly well-suited to policy simulation in data-constrained environments.

Government coverage of loan interest rate differentials constitutes a fiscal expenditure, and numerous studies have assessed the macroeconomic effects of shocks to fiscal spending using various modeling approaches. Empirical studies examining the effects of positive fiscal shocks in developing economies suggest that fiscal policy shocks operate in a broadly similar manner to those in advanced economies, with unexpected increases in government spending having a positive impact on both output and private consumption (Ly, 2011). Furthermore, Rafique et al. (2024) find that the medium-term effects of fiscal policy in developing countries are stronger during recessions, with estimated fiscal multipliers ranging from 0.16 to 2.1. Studies that employ semi-structural models report broadly consistent findings. For instance, a study analyzing the monetary-fiscal policy nexus using a semi-structural model for a small open economy, calibrated for Mexico, finds that a positive public spending shock increases aggregate demand, albeit at the cost of worsening both the primary fiscal balance and the public sector borrowing requirement (André, Armijo, Espidio, & Sandoval, 2023).

In the context of credit, several studies have examined macro-financial shocks and their transmission. Using quarterly data for Luxembourg and the euro area over the period 2003–2019, Resende et al. (2024) employ a semi-structural New Keynesian model to analyze the nexus between financial and business cycles. Their results indicate that a tightening of credit conditions increases lending rates by 0.16 percentage points, reduces credit volumes, and leads to a peak output decline of approximately 0.25%. Similarly, another study applies a stylized DSGE model augmented with a financial sector to a small open economy, using Croatia as a case study. Beneš (2009) et al. find that a 10-percentage-point increase in domestic lending rates results in declines in consumption, output, wages, and employment. In our context, this mechanism would operate in the opposite direction.

In the case of Mongolia, there have been efforts to model the macroeconomy and assess the effects of shocks. The Natural Resource Governance Institute (NRGI) developed the Mongolia Macro-Fiscal Model, a semi-structural model tailored to the Mongolian economy (Baksa, Mihalyi, & Romhanyi, 2017). Using data from 2005 to 2016, simulation results suggest that a MNT 500 billion reduction in government real expenditure would decrease real GDP by

approximately 1% in the first year, while an equivalent reduction in public investment would lower GDP by around 1.5%, with these effects gradually diminishing over time.

Doojav and Gantumur (2023) developed an estimated New Keynesian model of a commodity-exporting economy for an integrated policy framework and applied it to Mongolia. Their findings indicate that an increase in government spending boosts aggregate demand and expands output. Quantitatively, a 10% increase in government spending raises output by 0.8% and imports by 0.9% on impact.

In addition, the impacts of a policy to restore debt sustainability through expenditure cuts and tax increases were evaluated using a static CGE model (Galindev, et al., 2019a). The results suggest that fiscal consolidation to achieve targeted budget deficits would lead to changes in real GDP ranging from –8.7 percent to +4.4 percent, depending on the scenario. Furthermore, simulations of fiscal expansion associated with the 2020 parliamentary elections indicate a declining GDP trajectory, with the negative impact intensifying over time (Galindev, et al., 2019b).

From these findings, we can see that macroeconomic models have been widely used, both internationally and in Mongolia, to analyze the effects of various shocks. Existing studies demonstrate the value of different modeling approaches, including fully structural and semi-structural models, as well as empirical methods such as VAR, for evaluating fiscal and monetary interventions. While these models are designed to capture realistic economic dynamics, most applications focus on stylized policy scenarios rather than on specific, actively implemented programs, leaving a gap in understanding how concrete interventions unfold in practice. This gap is particularly relevant in Mongolia's non-mining sector. This study addresses this by examining a government-subsidized loan program that supports food and agricultural production and by using a semi-structural modeling framework to provide insights into its fiscal and macroeconomic consequences.

3 Background, methodology, and data

3.1 Overview of the "Program for Supporting Food and Agriculture Production."

In June 2022, the Parliament of Mongolia passed Resolution No. 36, titled "Some Measures to Ensure Food Supply and Security". To support this initiative, the Parliament's Temporary Committee issued Resolution No. 02, and the Government of Mongolia adopted Resolution No. 63 in 2023, titled "Some Measures Regarding Technological Work in the Food Supply and Agricultural Sector". All three resolutions aimed to bolster domestic food and agricultural production by offering subsidized loans through commercial banks.

Under this program, loans supporting food and agricultural production and working capital are offered at an annual interest rate of 18% (with borrowers paying 5% and the government subsidizing 13%) for a maximum term of 36 months. Loans for investment purposes are offered at an annual interest rate of 19% (with borrowers paying 6% and the government subsidizing 13%) for a maximum term of 60 months.

Parliament's Resolution No. 36 directed the government to take specific actions in five key areas to promote the national “Food Supply and Security” movement:

- Improve the legal framework for the food, agriculture, and light industry sectors.
- Enhance management and organization within the sector.
- Support crop production.
- Promote livestock production.
- Develop the food processing industry.

The loans evaluated in this study generally relate to the last three areas. Loans under the program have been disbursed through nine commercial banks starting in April 2023.

Table 1 presents the total loan amounts and the number of borrowers across the three main sectors: food processing, crop production, and livestock. A total of MNT 982 billion was approved for the “Program for Supporting Food and Agriculture Production”, and from April 2023 to December 2023, MNT 832.7 billion was disbursed to 1,956 borrowers (1,067 enterprises and 889 individuals). Of this, MNT 592.1 billion (71.1%) was allocated to 499 borrowers in the food sector, MNT 186.5 billion (22.4%) to 1,317 borrowers in crop production, and MNT 54.2 billion (6.5%) to 140 borrowers in the livestock sector.

Table 1. Loans provided under the program and the number of borrowers, by sector and month

Year/ month	Food processing		Crop		Livestock		Total amount of loan	Number of borrowers	Average amount of loan*
	Amount of loan*	Number of borrowers	Amount of loan*	Number of borrowers	Amount of loan*	Number of borrowers			
2023/04	4,475.4	20	14,963.3	208	70.0	1	19,509	229	85
2023/05	64,060.4	126	69,007.1	698	4,082.0	25	137,150	849	162
2023/06	122,759.6	127	36,665.2	260	22,112.0	48	181,537	435	417
2023/07	96,087.7	59	14,684.5	49	13,265.0	22	124,037	130	954
2023/08	19,714.6	35	5,559.3	33	5,395.0	19	30,669	87	353
2023/09	44,718.5	36	3,490.9	23	663.5	8	48,873	67	729
2023/10	35,537.0	22	2,043.1	12	2,031.4	5	39,611	39	1,016
2023/11	73,011.0	23	13,476.4	12	727.0	3	87,214	38	2,295
2023/12	131,691.9	51	26,592.9	22	5,850.0	9	164,135	82	2,002
Total	**592,056**	**499**	**186,483**	**1,317**	**54,196**	**140**	**832,735**	**1,956**	**426**

Source: Ministry of Food, Agriculture and Light Industry (MOFALI)
*Note: * -MNT million*

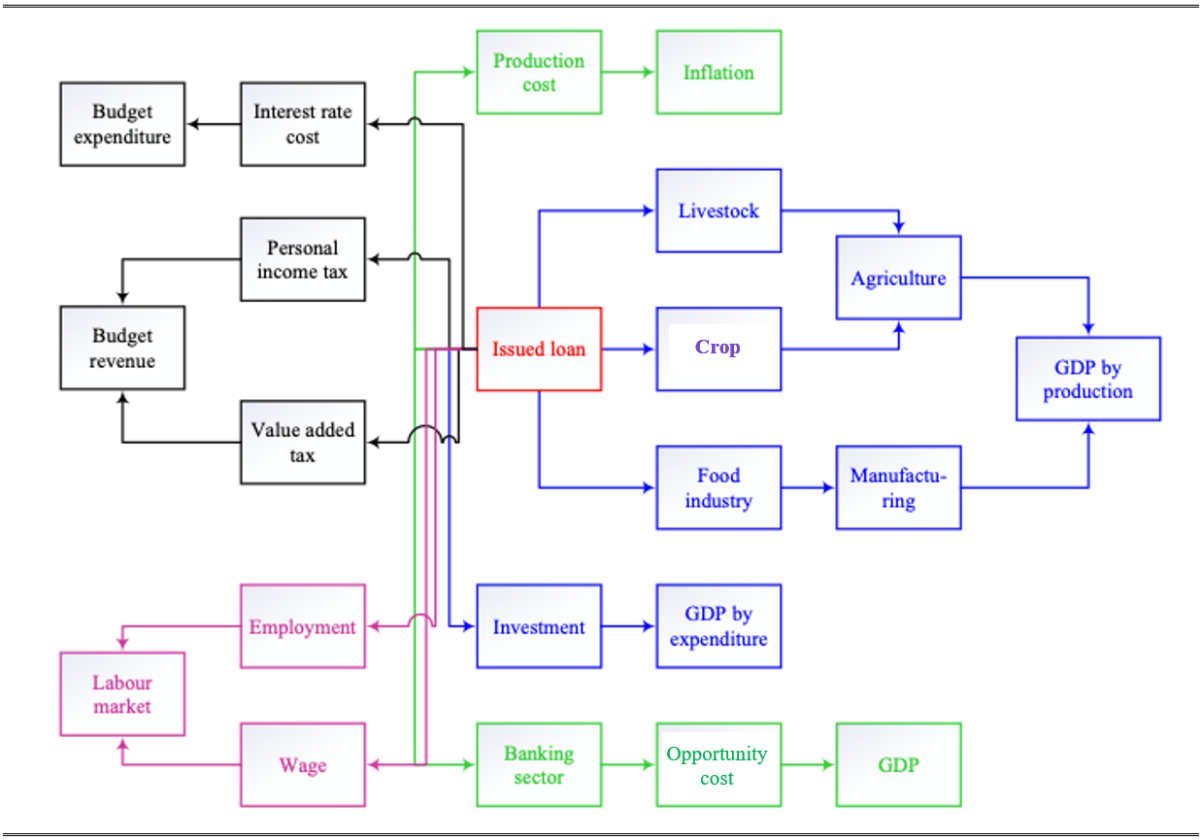
Of the total loans disbursed, MNT 421.7 billion was provided as investment loans to 366 borrowers, while MNT 411.0 billion was provided as working capital loans to 1,590 borrowers. The largest single loan granted to a borrower was MNT 20 billion, and the smallest was MNT 1.2 million. Loan disbursements were particularly active in May 2023 (MNT 137.2 billion), June (MNT 181.5 billion), July (MNT 124.0 billion), and December (MNT 164.1 billion), collectively accounting for 72.9% of the total loans issued.

3.2 Methodology for costing the loan program

3.2.1 Economic impact channels of the program

One of the key features of the program for supporting food and agriculture production is that commercial banks independently assess and make loan decisions without relying on any government organization. They issue loans using their own resources, with the government subsidizing only the interest rate differential. Figure 1 illustrates the potential impact of the subsidized loan program.

Figure 1. Potential impact of the loan program



Source: Authors' assumption

Because commercial banks make lending decisions based on profit motives, the loans provided to the food, crop, and livestock sectors reflect opportunity costs: if the same funds had been allocated to other economic sectors, the resulting effects would have been different (Figure 1, part highlighted in green in the lower right part). At the same time, government coverage of the interest rate differential reduces the credit risk for the banks. Because program loans are allocated as investments in these three sectors, they affect the investment component of GDP's expenditure side. In addition, through production activities, the loans generate direct effects on GDP in the food, crop, and livestock sectors (Figure 1, part highlighted in blue on the right. The investment also creates new jobs in each sector, influencing the labor market, including employment levels and wages within these sectors (Figure 1, part highlighted in pink in the lower left). The expansion of investment leads producers in the food, crop, and livestock sectors

to purchase new equipment, construct facilities, and increase output, thereby raising their tax obligations. Simultaneously, the creation of new jobs is expected to increase personal income tax (PIT) revenue. It should be noted that other tax revenues related to these sectors' activities may also increase.

Under the program, working capital loans are provided with a total annual interest rate of 18% (5% paid by borrowers, 13% subsidized by the government) for up to 24 months, while investment loans carry a total annual rate of 19% (6% by borrowers, 13% by the government) for up to 60 months. These subsidized interest payments affect the fiscal expenditure side (Figure 1, the part shown in black in the upper-left). The 13% government subsidy on both working capital and investment loans not only reduces the interest burden on borrowing producers but also creates conditions for lower production costs over the medium and long term. Consequently, the program loans are expected to influence supply-driven inflation through their effects on production in these sectors (Figure 1, upper-right panel highlighted in green).

3.2.2 On the model and data for estimating the total economic impact of the program

In general, the evaluation of policy costs typically relies on models that generate short-, medium-, and long-term projections. These can include purely data-driven models, such as vector autoregressive (VAR) models; semi-structural models, such as the "GAP" model or CGE models; or fully structural theoretical models, such as dynamic stochastic general equilibrium (DSGE) models. Semi-structural models provide a useful compromise, combining theory-consistent behavioral relationships with empirical flexibility. This allows them to capture key macroeconomic dynamics and evaluate policy and structural shocks more effectively than purely empirical models, while avoiding the restrictive microeconomic assumptions of DSGE frameworks (Baksa, Mihalyi, & Romhanyi, 2017).

To evaluate the macro-level effects of the loan program, as well as certain behavioral effects, we base our analysis on the "GAP" model, which belongs to the class of semi-structured models. It was first developed by the "OG Research" company, based in Prague, Czechia (with a branch in Budapest, Hungary), and is currently used to provide consulting services to central banks and government research institutions in developing and newly industrialized countries.

To conduct policy costing, it is necessary to use a macroeconomic model that adequately reflects the structural characteristics of the Mongolian economy, is based on internationally recognized methodologies, and is calibrated and validated using actual data. One such model that satisfies these requirements is the Mongolia Macro-Fiscal Model (MMM) developed by Baksa et al. at the NRGI in 2017[5]. This model is slightly modified, updated, and used by the authors to evaluate the loan program in this study.

[5] The full Mongolia Macro-Fiscal Model is publicly available on the NRGI website, including the model guide (Mongolia Macro-Fiscal Model: Model Guide) and the technical appendix (Mongolia Macro-Fiscal Model - Technical Appendix: Equations, variables, parameters), both of which can be accessed online.
Model guide: https://resourcegovernance.org/sites/default/files/documents/mongolia-macro-fiscal-model-guide.pdf

The MMM was developed to project a baseline scenario and to assess how different shocks or policy changes would affect the trajectories of key macroeconomic and fiscal variables over a 20-year horizon. The model comprises three main sections: (i) the macroeconomic model, (ii) the mineral sector block (iii) the fiscal block. Combining these sections enables the capture of key linkages among the mineral sector, the budget, and the overall economy.

The following assumptions and associated limitations apply to the model. The model's assumptions can be generally categorized into three sections: aggregate demand, aggregate supply, and monetary policy.

- It considers a small, open economy.
- All endogenous variables are expressed as the sum of gaps (short term) and trends (medium term).
- In the short term, the price level is inflexible or rigid, while in the medium term, the price level is flexible.
- Gaps in aggregate demand and output are determined by internal and external factors in the monetary market.
- Aggregate supply, or the Phillips curve, defines changes in the domestic price level or the CPI.
- The central bank stabilizes aggregate supply by affecting aggregate demand responses through its influence on nominal interest rates or nominal exchange rates.

The model features a detailed decomposition of both aggregate demand and the production side of the economy. On the supply side, output is disaggregated into agricultural, mining, and core sectors (Eq. 1), while aggregate demand comprises household consumption, investment, government consumption, and net exports (Eq. 4). Expectations play a central role in shaping contemporaneous macroeconomic outcomes. Household consumption depends on both current monetary conditions and expectations of future developments, which adjust endogenously in response to economic interactions and monetary policy. In the short run, price rigidities allow monetary policy to influence real activity through real interest rates, while expectations shape firms' price-setting behavior in response to anticipated domestic demand and external inflation pressures. In a small open economy, movements in nominal and real exchange rates influence inflation dynamics and net exports. Real economic performance and labor market conditions, particularly in the mining sector, affect the fiscal primary balance, which feeds back into growth through its impact on the sovereign risk premium. Commodity prices provide an additional transmission channel, driving short-run sectoral activity and, when persistent, improving medium-term prospects by supporting investment, incomes, and fiscal space (Baksa, Mihalyi, & Romhanyi, 2017).

The full system of equations in the original model is adopted without modification, except that iron prices are replaced with coal prices to better reflect Mongolia's export structure, as shown below.

Technical appendix: https://resourcegovernance.org/sites/default/files/documents/mongolia-macro-fiscal-appendix.pdf

In the model, aggregate supply is divided into agricultural (y^{agr}), mining (y^{mine}), and core (y^{core}) components:

$$\hat{y}_t = w^{y,agr} \cdot \hat{y}_t^{agr} + w^{y,mine} \cdot \hat{y}_t^{mine} + (1 - w^{y,agr} - w^{y,mine}) \cdot \hat{y}_t^{core} + \sigma \cdot \varepsilon_t^{\hat{y}} \quad (1)$$

The mining sector output gap depends not only on its own past dynamics but also on external demand conditions and international commodity prices:

$$\hat{y}_t^{mine} = \rho^{\hat{y}^{mine}} \cdot \hat{y}_{t-1}^{mine} + \left(1 - \rho^{\hat{y}^{mine}}\right) \cdot \left(\psi_1 \cdot \hat{y}_t^{FD} + \psi_2 \cdot \widehat{rp}_t^{Commodity}\right) + \sigma \cdot \varepsilon_t^{\widehat{y^{mine}}} \quad (2)$$

Here, $\widehat{rp}_t^{Commodity}$ denotes the weighted real price gap of available commodities in the mining sector, while $\hat{y}_t^{FD}$ represents the effective foreign demand gap. In contrast to the original model specification, which incorporates copper and iron prices, this study replaces iron prices with coal prices in eq (3).

$$\widehat{rp}_t^{Commodity} = w^{Com} \cdot \widehat{rp}_t^{Copper} + (1 - w^{Com}) \cdot \widehat{rp}_t^{Coal} \quad (3)$$

Agricultural output is treated as an exogenous process, with short- and medium-term fluctuations driven primarily by weather conditions and the steady-state growth assumptions. The core sector lacks an explicit production-side specification; instead, its dynamics are determined implicitly by GDP identities and, on the demand side behavioral equations. We acknowledge that treating agricultural output as exogenous is a limitation, given that the program is partly intended to raise agricultural production. However, crop and livestock loans account for only about 29% of total program lending, while food processing, which enters the core sector, accounts for the remainder, so this assumption constrains only a minority of the simulated shock. In the revised simulation, the crop and livestock portion of the loan is introduced as a shock to the agricultural output trend rather than being treated as purely weather-driven.

On the demand side, aggregate output is composed of consumption (c), investment (inv), government expenditure (gov), and net exports ($ex - im$):

$$\hat{y}_t = w^{y,c} \cdot \hat{c}_t + w^{y,inv} \cdot \widehat{inv}_t + w^{y,gov} \cdot \widehat{gov}_t + w^{y,ex} \cdot \widehat{ex}_t - w^{y,im} \cdot \widehat{im}_t + \varepsilon_t^{\widehat{y^{core}}} \cdot \sigma \quad (4)$$

Private consumption is modeled following the New Keynesian framework as a function of hybrid expectations, the effective real interest rate, household income, and agricultural output. Investment dynamics also follow a hybrid expectation structure and depend on the implicit value of the invested capital, represented by Tobin's Q. The Tobin-Q shows the present value of payoffs from the current investment, which is proxied by the cyclical position of output and real price of commodities:

$$\widehat{inv}_t = \beta_1 \cdot \widehat{inv}_{t-1} + \left(1 - \beta_1\right) \cdot \widehat{inv}_{t+1} + \beta_2 \cdot Q_t + \sigma \cdot \varepsilon_t^{\widehat{inv}} \quad (5)$$

$$Q_t = \beta_3 \cdot Q_{t+1} + \beta_4 \cdot \hat{y}_t + \beta_5 \cdot \widehat{rp}_t^{Commodity} - \beta_6 \cdot \hat{r}_t \quad (6)$$

While the commodity export gap is a function of available commodities and depends weakly on the real exchange rate and foreign demand, non-mining activity fluctuates with international business cycles and the cyclical position of the real exchange rate. Imports can be given as a function of consumption, investment, and re-exported imports.

Fiscal dynamics are captured through a fiscal block in which the cyclical primary balance depends on consumption, income, mining activity, and the government spending gap, while the trend reflects the cyclically adjusted position. Fiscal policy primarily affects the economy via the risk-premium channel, whereby weaker fiscal balances raise borrowing costs and dampen growth. Inflation is modeled using a New Keynesian Phillips curve incorporating expectations, the output gap, exchange rate movements, imported inflation, and commodity price shocks. Monetary policy operates under a dual mandate, with an implicit inflation target and partial exchange-rate management, following a smoothing rule that adjusts interest rates in response to deviations from the inflation target. In the medium term, real interest rates are determined by external financial conditions under real UIP, while nominal variables are assumed to be neutral (Baksa, Mihalyi, & Romhanyi, 2017).

In addition, some observational variables necessary for medium-term projections are included. The updated model has 261 equations and 261 variables, and most of the structural equations are formulated around the "gap", or the difference between endogenous variables and their trend or long-term tendency. Regarding model parameters, 277 were calibrated and 23 estimated. These 300 parameters are used directly without any modification. Finally, the database for the NRGI model (originally covering the period from the first quarter of 2005 to the third quarter of 2016) is updated through the end of the second quarter of 2023. The baseline forecast covers 2023–2028 (this model will be referred to as the baseline projection model).

For the macroeconomic projections for the medium term (2023-2028), the following assumptions or limitations were applied:

- No supply disruptions or border restrictions will occur.
- There will be no droughts or severe winters.
- The supply of oil products will remain stable, and contract prices will not change.
- There will be no significant adverse shocks to the markets for key export commodities.
- Investment in the Oyu Tolgoi underground mine construction will proceed as planned in 2024 and 2025.
- The policy rate will remain unchanged in Q3 and Q4 of 2023, and Q1 and Q2 of 2024.
- Future values for some key variables will be based on short- and medium-term projections from the Bank of Mongolia, World Bank, International Monetary Fund, and Asian Development Bank.

One of the simulation assumptions worth noting is that the large-scale expansion of lending under the program does not generate crowding-out effects on credit supply to other sectors. While reasonable under prevailing financial conditions, this assumption may be less valid in tighter monetary or liquidity environments.

To assess the potential impact of the loan program on the economy, we employ a shock analysis on the baseline projection model. This involves introducing specific changes ("shocks") to the model using the program loans, other relevant data, and additional required calculations, and observing how these changes affect key economic and financial variables, as well as main sectors and labor market indicators. (In addition to program loan data obtained from MOFALI, we conducted a sample survey of enterprises that received loans under the program to collect specific information useful for the analysis, particularly for calibrating the shock amount and ensuring the accuracy of the input-output table. For more details on the sample survey, see the Appendix.) Following these simulations, we compare the results with the baseline model to identify the program's potential effects. Figure 1 plays a crucial role in guiding the selection and placement of these "shocks" within the model. By visually depicting the potential program impacts, we can target specific areas of the baseline model for analysis.

The results of the baseline projection model are compared with those of the Bank of Mongolia (Inflation report, Q1-Q4 2023), World Bank (June 2023; January 2024), and the International Monetary Fund (July 2023; October 2023; January 2024), and are based on specific assumptions.

3.2.3 Identification and limitations

It is important to clarify the interpretive status of the estimates reported below. The analysis introduces the program as an exogenous shock to a calibrated macro-fiscal model and compares the simulated paths with a baseline projection; it is therefore an ex-ante policy-costing simulation rather than an empirically identified impact evaluation. The design does not establish a firm-level counterfactual, and it does not separate the program's effect from the broader macroeconomic recovery, inflation, commodity conditions, or pre-existing firm growth. Because commercial banks selected borrowers on the basis of size and creditworthiness, participation in the program is non-random and no valid control group is available; the accompanying enterprise survey (see Appendix) is a purposive sample of the largest recipients rather than a representative panel, and is therefore used only to calibrate the model, not as evidence of impact. A firm-level design such as difference-in-differences or an event study is not feasible in this setting, because the program involved neither randomization nor an eligibility discontinuity and selection on creditworthiness is non-ignorable. Accordingly, the magnitudes reported in this section should be interpreted as model-implied effects that hold under the stated assumptions, and we moderate the causal language throughout. In place of a causal design, we probe the robustness of the estimates through the scenario and sensitivity analyses reported below.

4 Results

Policy costs are changes in government revenues and expenditures at the national and subnational levels resulting from policy measures. These effects are typically assessed at three levels: (i) static effects, (ii) behavioral effects, and (iii) second-round (macroeconomic) effects.

Static effects capture the immediate fiscal impact of a policy following its implementation and are often used for simplified, approximate estimations. Behavioral effects arise from changes

in decision-making by individuals, households, and firms in response to policy changes, which in turn affect economic outcomes and fiscal balances. These effects are more complex to estimate and often require additional empirical analysis. Second-round effects refer to broader macroeconomic impacts that indirectly influence the budget through changes in variables such as prices, wages, labor allocation, capital flows across sectors, and sectoral production.

The effects of the subsidized loan program at three levels are presented in detail in the following subsections.

4.1 Direct effects on the budget

Subsidized loans issued in 2023 to support agriculture and food production have slightly different terms depending on the loan type. The investment loan (non-current asset loan) has an interest rate of 6% per annum, a 5-year term, and the borrower will be exempt from principal repayments for the first 12 months. The working capital loan has a 5% annual interest rate and a 3-year term, with the borrower exempt from principal payments for the first 6 months. The borrower will pay the loan interest each month according to the schedule, while the government will transfer the 13% interest subsidy to the commercial banks monthly.

According to the MOFALI, in this program, MNT 338.2 billion in loans were granted in the second quarter of 2023, MNT 203.6 billion in the third quarter, and MNT 291.0 billion in the fourth quarter. Therefore, in this estimation, we assumed that the MOFALI started paying the interest subsidy from the 2023 Q3. Accordingly, it was considered that the interest subsidy for working capital loans will continue until the end of 2026 Q4, and for investment loans until the end of 2028 Q4.

Taking into account the above terms, Table 2 shows the interest subsidy expenditures from the state budget in the coming years for the MNT 832.7 billion program loan granted in 2023. The nominal amount of total expenditure for that program is MNT 271.6 billion.

Table 2. The direct burden of the program on the state budget, MNT billion

	2023	2024	2025	2026	2027	2028	Total
Interest subsidy	28.6	102.8	74.9	40.5	19.1	5.7	271.6

Source: Authors' calculation

The additional workload for government institutions involved in implementing the loan program was incorporated into the job descriptions of responsible officials and reflected in their organizations' budgets. However, these additional costs were considered negligible compared to the overall program subsidy. Consequently, the program's direct budgetary impact is best assessed by referring to the figures presented in Table 2.

4.2 Direct (static) effects on the economy

As illustrated in Figure 1, the subsidized loan program has a direct macroeconomic impact, with the primary effect on GDP, particularly in the food processing, crop, and livestock sectors. However, loans provided to these sectors do not translate directly into GDP, as a portion is used for intermediate consumption and imports. We calculate this using data from the Input-Output

table to compute the total production or consumption percentage for these three sectors, which is the average final product or GDP. This result is indicated in Table 3. Here, we employ the 55x55 Input-Output tables for 2012, the 32x32 tables for 2015, and the 32x32 tables for 2019 to compare final consumption with total consumption and to calculate the program's loan-to-GDP conversion factor. It was used to calculate the conversion rate of loans issued by each sector to GDP.

Table 3. Conversion factor of program loans to GDP

	Sector	2012	2015	2019	Average	Loan amount, MNT million	Estimated GDP contribution, MNT million
1	Crop	0.346	0.360	0.354	0.353	186,483	65,899
2	Livestock	0.576	0.632	0.498	0.568	54,196	30,802
3	Food processing	0.877	0.860	0.884	0.874	592,056	517,390
	Total	-	-	-	-	832,735	614,091

Source: Authors' calculation

According to Table 3, from MNT 592.1 billion loaned to the food processing sector, MNT 517.4 billion contributes to GDP. This translates to a contribution rate of around 87.4%. In contrast, loans to the crop and livestock sectors contribute less to GDP. Only MNT 65.9 billion out of the MNT 186.5 billion loaned to the crop sector contributes to GDP (roughly 35.3%). Similarly, only MNT 30.8 billion of the MNT 54.2 billion loaned to the livestock sector contributes to GDP (approximately 56.9%). In total, the MNT 832.7 billion of subsidized loans increases nominal GDP in 2023 by MNT 614.1 billion.

Because this conversion step is decisive for the results, particularly given the high food-processing factor, we do not rely on a single point estimate. Using the three available input-output tables (2012, 2015, and 2019), which span a period of structural change, we construct a range of conversion factors, taking the lowest across vintages as a conservative case, the 2019 table (or the cross-vintage average) as the central case, and the highest as an optimistic case. Post-2021 import frictions, higher transport costs, and exchange-rate depreciation tend to raise the imported and intermediate share of food processing and thus lower the conversion factor; the survey evidence that 42.9% of investment loans and 18% of working-capital loans were spent on imports (see Appendix) supports treating the high central factor as an upper bound. The resulting GDP ranges are reported in the sensitivity and scenario analysis below.

By converting the nominal GDP of each sector to real GDP using a seasonal GDP deflator, the combined results show that, with the loan implementation, the program would generate an additional 1.14% of economic growth in 2023 compared to 2022. This can be considered the program's direct impact on the macroeconomy. Table 4 demonstrates the results of real GDP estimates for each sector by quarter, disaggregated by investment and working capital loans.

Table 4. A detailed calculation of the real GDP conversion rate of program loans

Conversion amount to nominal GDP, MNT million				
	Loans for the food sector		Loans for the agriculture sector	
	Investment	Working capital	Investment	Working capital
2023 Q3	179,133.8	128,313.8	22,822.4	54,103.7
2023 Q4	111,028.1	98,914.4	13,031.3	6,742.7
Conversion amount to real GDP, MNT million				
	Loans for the food sector		Loans for the agriculture sector	
	Investment	Working capital	Investment	Working capital
2023 Q3	58,930.5	42,212.0	10,699.5	25,364.7
2023 Q4	40,221.4	35,833.0	3,968.9	2,053.6

Source: Authors' calculation

Since the medium-term baseline projection model starts in Q3 2023, program loan shocks were applied by rolling loans from Q2 2023 into Q3. Total subsidized loans will increase nominal GDP by MNT 614.1 billion in 2023, while real GDP calculated at 2010 prices will increase by MNT 219.3 billion (a 1.14% increase).

While many constraints may reduce the program loan's impact on GDP, a lack of data hinders our ability to quantify and account for the detailed effects of each constraint. However, some limitations will be considered and factored into the estimate of the program loan's indirect behavioral impact.

4.3 Indirect and behavioral effects

Investment loans (50.6% of total loans) affect the sector's long-term trend, while working capital loans (49.4% of total loans) influence the GDP gap and short-term fluctuations. Using the results of converting the nominal GDP of each of these sectors into real GDP using the seasonal GDP deflator (Table 4), we introduced shocks into the baseline projection model by adjusting the sectoral GDP gaps and trends, and applied the following assumptions to estimate the effect of the program loans:

- Since investment loans are used to purchase equipment and construct factories and facilities, it takes some time to start having a real effect on production. Therefore, 50% of the investment loan's proceeds were transferred to 2024. This assumption is based on research in capital investment theory, consultations with representatives of borrowing enterprises, and information from approximately 150 enterprises included in surveys conducted by the MOFALI and the Economic Research Institute (ERI).
- 25% of the impact of working capital loans is assumed to begin in 2024, as loans obtained at the end of 2023 are unlikely to have a direct effect within the same year.

Applying the two assumptions above alters the previously estimated static impact of the program loans on 2023 GDP. According to earlier calculations (Table 4), the effect of investment loans in the food sector on 2023 real GDP was MNT 99.1 billion; if 50% of this

effect is delayed to 2024, the impact in 2023 would be MNT 49.6 billion. Similarly, the impact of investment loans in the agriculture sector on the 2023 real GDP was MNT 14.7 billion, which would be reduced to MNT 7.3 billion in 2023. For working capital loans, the 2023 real GDP impact in the food sector was MNT 78.0 billion, of which 25% is assumed to take effect in 2024, resulting in MNT 58.5 billion in 2023. In the agriculture sector, the 2023 real GDP impact of working capital loans was MNT 27.4 billion, which becomes MNT 20.6 billion in 2023 under this assumption.

Considering both assumptions together, the total impact of the program loans on 2023 real GDP is estimated at MNT 136.0 billion, equivalent to 0.7% growth compared to 2022. The differences between the model with program effects and the baseline projection model for key variables are presented in Table 5.

Table 5. Indirect and behavioral effects of the program loans

Macroeconomic variables						
#	**Variable (2010 constant price, MNT billion)**	**2023**	**2024**	**2025**	**2026**	**2027**
1	GDP	135.5	321.5	375.5	404.0	426.6
2	Private consumption	52.1	156.9	196.1	218.5	234.8
3	Government consumption	17.8	51.5	64.4	73.5	80.3
4	Gross capital formation	34.7	99.3	130.1	144.3	153.8
5	Export	81.4	223.9	286.6	314.9	330.1
6	Import	-26.3	104.6	220.3	280.8	311.5
7	GDP: Agriculture	38.8	120.2	142.1	151.9	156.9
8	GDP: Mining	0.1	0.1	4.8	7.3	8.6
9	GDP: Other	97.9	211.5	237.6	251.8	265.2
GDP deflators						
#	**Deflator**	**2023**	**2024**	**2025**	**2026**	**2027**
1	GDP	-0.001	-0.005	-0.006	-0.010	-0.013
2	Private consumption	-0.001	-0.006	-0.010	-0.013	-0.015
3	Government consumption	-0.001	-0.005	-0.009	-0.012	-0.014
4	Gross capital formation	-0.001	-0.005	-0.008	-0.011	-0.013
5	Export	0.000	0.002	0.004	0.003	0.002
6	Import	0.000	0.000	-0.001	-0.002	-0.003
7	GDP: Agriculture	-0.002	-0.007	-0.010	-0.012	-0.015
8	GDP: Mining	0.000	0.009	0.015	0.013	0.011
9	GDP: Other	-0.001	-0.005	-0.008	-0.011	-0.015
Macroeconomic variables						
#	**Variable (current price, MNT billion)**	**2023**	**2024**	**2025**	**2026**	**2027**
1	GDP	416.8	1,010.6	1,305.4	1,453.2	1,577.4
2	Private consumption	112.4	341.6	428.6	486.1	533.3
3	Government consumption	35.6	102.9	130.0	152.6	171.6
4	Gross capital formation	66.1	189.5	251.0	282.8	306.5
5	Export	146.0	472.9	733.4	818.7	863.3

6	Import	-38.4	127.5	267.9	331.9	357.3
7	GDP: Agriculture	93.7	304.8	385.8	434.0	469.8
8	GDP: Mining	0.6	44.9	119.5	134.1	134.2
9	GDP: Other	279.7	588.0	713.8	779.5	839.9
Financial market variables						
#	**Variable**	**2023**	**2024**	**2025**	**2026**	**2027**
1	Policy rate, %	0.001	-0.030	-0.076	-0.077	-0.066
2	CPI, %	-0.062	-0.179	-0.120	-0.083	-0.063
3	Risk premium, %	0.064	0.060	0.002	-0.006	-0.005
Labour market variables						
#	**Variable**	**2023**	**2024**	**2025**	**2026**	**2027**
1	Private sector employment	718	5,442	7,469	8,749	9,657
2	Employment: Agriculture	-1,588	385	689	706	707
3	Employment: Mining	22	16	23	26	27
4	Nominal wage growth, %	0.1	0.2	0.0	0.0	0.0
5	Nominal wage growth: Agriculture, %	0.2	0.4	-0.1	-0.1	-0.1

Source: Authors' calculation

Based on the effect of program loans, the actual GDP calculated at 2010 prices between 2023, 2024, 2025, 2026, and 2027 will be MNT 135.5 billion, MNT 321.5 billion, MNT 375.5 billion, MNT 404 billion, and MNT 426.6 billion, respectively. By comparing the real GDP, measured in 2010 prices, under the program loans with the baseline projection model, the impact of the program is estimated to increase real GDP by MNT 135.5 billion in 2023, MNT 321.5 billion in 2024, MNT 375.5 billion in 2025, MNT 404.0 billion in 2026, and MNT 426.6 billion in 2027. Correspondingly, Table 5 allows a detailed view of how the program affects the expenditure components of real GDP for 2023–2027 in 2010 prices. Overall, the program appears to have a positive effect on all components of GDP over the medium term.

In addition, the program is projected to reduce the annual growth rate of the CPI (inflation) by 0.1 percentage point in 2023, 0.2 percentage points in 2024, and 0.1 percentage point in each of 2025, 2026, and 2027. Employment in the agriculture sector is expected to show a continuous upward trend over the medium term, except in 2023, with a positive impact on nominal wage growth. However, the impact on employment and nominal wage growth in the food sector cannot be calculated directly, as the model used aggregates GDP into only three sectors: agriculture, mining, and other sectors. To partially fill this gap, we approximate the food-processing employment and wage-bill effects outside the macro model by applying Type I employment multipliers derived from the input-output table to the estimated food-processing GDP shock; these input-output-based figures are reported separately and should be read as approximations rather than model-consistent outcomes.

Table 6 presents the differences in real GDP, its sectoral decomposition, and the growth of individual expenditure components of real GDP between the baseline projection and the model with program shocks. From this, it can be concluded that the program loans have a stronger effect on total real GDP, agriculture's real GDP, other sectors' real GDP, and the components

of real GDP in 2023 and 2024, while the effect gradually diminishes in subsequent years. For example, the difference in real GDP growth between the baseline model and the model with program shocks will be 0.7% in 2023, and 0.9% in 2024, and this difference will continue to decrease until it becomes zero in 2027 and 2028.

Table 6. Indirect and behavioral effects of program loans: Differences in growth of real GDP, its sectors, and expenditure components

#	Variable (2010 constant price)	2023	2024	2025	2026	2027
1	GDP	0.7	0.9	0.2	0.1	0.0
2	Private consumption	0.4	0.8	0.2	0.1	0.0
3	Government consumption	0.5	0.8	0.2	0.1	0.1
4	Gross capital formation	0.4	0.8	0.3	0.1	0.0
5	Export	0.4	0.4	0.1	0.0	0.0
6	Import	-0.1	0.4	0.3	0.1	0.0
7	GDP: Agriculture	1.4	3.0	0.7	0.3	0.1
8	GDP: Mining	0.0	0.0	0.1	0.0	0.0
9	GDP: Other	0.7	0.8	0.1	0.0	0.0

Source: Authors' calculation

4.4 Sensitivity and scenario analysis

Because several assumptions are central to the results, we assess their robustness along three dimensions. First, applying the conservative-central-optimistic conversion-factor band described above yields a 2023 static real-GDP contribution of roughly 0.96% to 1.19%, around the central estimate of 1.14%. Second, varying the two key behavioral assumptions, namely the share of the investment-loan effect delayed to 2024 (central 50%) over a 30-70% range and the share of the working-capital effect delayed (central 25%) over a 0-40% range, yields a 2023 real-GDP contribution of about MNT 97 billion to MNT 185 billion (approximately 0.5% to 1.0%), compared with the central MNT 136 billion (0.7%). Third, whereas the baseline assumes no crowding-out of credit to other sectors, introducing partial crowding-out, in which 25% to 50% of program lending displaces other lending valued at an average conversion factor, reduces the 2023 net contribution to about MNT 115 billion and MNT 95 billion, respectively. The no-crowding-out baseline reflects the substantial excess liquidity in the Mongolian banking system in the post-COVID-19 period and would be less valid under tighter conditions. Overall, the qualitative conclusion of a positive but moderate and temporary contribution is robust, while the precise magnitude is sensitive to the conversion and behavioral assumptions.

These gains should be weighed against the direct fiscal cost of the subsidy, a nominal MNT 271.6 billion (Table 2), which implies a modest per-unit cost of additional output. This comparison, however, does not net out the opportunity cost of any displaced lending or the deadweight associated with inframarginal loans that would have been extended in the absence of the subsidy. The distributional incidence also favors larger enterprises, since program lending is concentrated among the largest recipients; a fuller welfare and distributional assessment is left to future work.

5 Conclusion

This study applied a policy-costing framework, based on a semi-structural macro-fiscal model, to estimate the budgetary and economic effects, under stated assumptions, of Mongolia's 2023 subsidized-loan program supporting food and agricultural production. The simulations suggest that, under the model's assumptions, the program is associated with a positive contribution to real GDP in the short and medium term, relative to the direct cost of the government-paid loan subsidy. The strongest effects were observed in the earlier period in 2023–2024. These gains were driven primarily by increased investment and working capital in the food processing and agricultural sectors, leading to higher output, employment growth, and expanded private consumption. The program is also projected to slightly reduce inflation through supply-side channels while increasing tax revenues via higher production and labor income. However, the growth effects gradually diminish over time, suggesting that the program provides a moderate but temporary stimulus rather than a permanent increase in potential output.

Several considerations qualify the interpretation of these findings. Most importantly, the estimates are model-implied effects under stated assumptions rather than causally identified impacts, since the analysis compares simulated paths with a baseline projection and does not exploit a firm-level counterfactual or a valid control group. First, the analysis relies on a semi-structural model that aggregates the economy into three broad sectors, thereby limiting the precision with which sector-specific labor market and wage effects, particularly in food processing, can be captured. Second, firms' behavioral responses are incorporated through calibrated assumptions and survey evidence rather than fully estimated structural relationships, reflecting data constraints common in developing economies. Third, the simulations assume that the large-scale expansion of lending under the program does not generate crowding-out effects on credit supply to other sectors. This assumption is based on discussions with banking sector experts who indicate that the Mongolian banking system has maintained substantial excess liquidity, particularly in the post-COVID-19 period, allowing banks to expand lending without reducing credit to other sectors. While reasonable under prevailing financial conditions, this assumption may be less valid in tighter monetary or liquidity environments.

From a policy perspective, the findings indicate that subsidized loan programs can serve as an effective instrument for supporting targeted sectors and stabilizing economic activity when they are well designed and fiscally transparent. However, the diminishing marginal impact over time highlights the need to complement credit support with productivity-enhancing reforms, including greater technology adoption, improved logistics, and expanded market access. In parallel, policymakers should monitor banking-sector liquidity conditions and embed contingency mechanisms to mitigate potential crowding-out risks in tighter monetary or financial environments. Future research could build on this framework by incorporating finer sectoral disaggregation, firm-level productivity dynamics, and distributional outcomes, including effects on wage and income inequality. More broadly, institutionalizing policy-costing practices within Mongolia's fiscal decision-making process would strengthen accountability, improve policy prioritization, and support evidence-based economic governance.

Appendix

Program participant survey

The primary objective of the survey was to generate additional data required for the macro-fiscal model. Accordingly, the enterprise-level figures reported below are used solely as calibration inputs for the model and are descriptive of program recipients; because the sample is purposive (the largest recipients) and the reference period coincides with the broader 2023 economic recovery and inflation, they should not be interpreted as causal effects of the program. The survey provided insights into how subsidized loan support affects the operations of participating enterprises and the potential direct spillover effects on other sectors of the economy. In doing so, it distinguishes between investment and working capital loans and compares the commonalities and differences in their impacts across the food, crop, and livestock sectors.

The survey data were collected using the following method:

- The study employed a purposeful sampling approach. Loan amounts varied across enterprises depending on their business activities, and selecting the enterprises that received the largest loans was considered most appropriate for evaluating impacts on the state budget and the broader economy.
- The sample size is 153 enterprises. Among the total 1,956 individuals and enterprises that participated in the subsidized loan program, the MOFALI had established control agreements with the 220 enterprises that received the largest loans. These enterprises were obliged to provide the information required for the program evaluation. Survey participants were selected from these 220 enterprises. The sample was designed to reflect representation across subsectors.

Amount of loan

Among the 153 enterprises included in the survey, a total of MNT 584.2 billion in subsidized loans was distributed. The food processing industry received the largest share of the loans (MNT 487.5 billion, representing 83.4% of the total). Loans allocated to the crop and livestock sectors were MNT 51.6 billion (8.9%) and MNT 45.1 billion (7.7%), respectively. Considering overlaps, 151 enterprises received loans for food processing, 20 enterprises for crop farming, and 11 enterprises for livestock production. The average loan amount per enterprise is MNT 3.8 billion.

Meat and meat products, along with flour and baked goods, are the dominant categories of products among loan recipients. For example, Table A1 shows that 24.6% of loans were extended to meat and meat product producers, while manufacturers of flour and baked products received 19.2%.

Table A1. Number of borrowers and loan shares, by product type

Product	Number	Loan share, %
Meat and meat product	39	24.6

Crop	22	7.3
Flour and baked products	16	19.2
Milk and dairy products	12	12.8
Packaging product	11	4.5
Food	11	10.9
Beverages	6	2.2
Fruits and berries	5	7.6
Other	31	10.9
Total	153	100.0

Source: Survey of loans to support food and agricultural production

Based on loan size, 12 enterprises received loans of at least MNT 10 billion (Table A2), with the largest loan amounting to MNT 30 billion. The most common loan bracket is MNT 1-2 billion, comprising 48 enterprises, followed closely by 47 enterprises with loans between MNT 2-4 billion. In contrast, the fewest enterprises, only 9, received loans of MNT 6-10 billion.

Table A2. Loan amount and number of borrowers (n=152)

Loan amount, MNT billion	Number of enterprises
Up to 1	25
1-2	48
2-4	47
4-6	11
6-10	9
More than 10	12
Total	152

Source: Survey of loans to support food and agricultural production

Loan spending

Among the 153 enterprises surveyed, 86 received investment loans for the purchase of technical equipment (55 enterprises), special vehicles (9 enterprises), or the construction/expansion of factories (38 enterprises). Of those who received investment loans, 489 pieces of machinery and equipment were purchased for a total of MNT 185.7 billion. Additionally, 53 special vehicles were acquired for MNT 2.9 billion.

The survey further revealed that a portion of the investment loans was spent on direct imports. Of the 39 enterprises that received investment loans, 25 imported machinery, equipment, and special vehicles. These imports amounted to MNT 94.4 billion, or 42.9% of their investment loans. Furthermore, 18 of the 52 enterprises participating in the working capital loan program spent MNT 46.4 billion of their loan financing on imported goods and products, accounting for 18% of their total loan amount.

Among enterprises that purchased machinery and equipment, 16 enterprises benefited from customs duty relief, totaling MNT 1.3 billion (Table A3).

Table A3. Imports and customs duty relief under investment loans

Purpose	Quantity	Import, MNT billion	Enterprises received customs duty relief	Customs duty relief, MNT billion	Number of enterprises imported (count includes duplicates)
Equipment	560	187.1	16	1.3	21
Special vehicles	53	2.9	-	-	2
Total	613	190.0	-	-	21

Source: Survey of loans to support food and agricultural production

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Малчин өрхийн орлогод үзүүлэх зудын нөлөө: Архангай аймгийн Хотонт сумын жишээн дээр

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Хураангуй

Энэхүү судалгаа нь Архангай аймгийн Хотонт сумын 56 өрхийн 1999-2001 оны гурван жилийн панел өгөгдөлд тулгуурлан зудын хам нөлөөт (covariate) болон хувь өрхийн (idiosyncratic) шокийн орлогын хэлбэлзэлд үзүүлэх нөлөөг шинжилсэн. Параметрийн бус Kruskal–Wallis шинжилгээний үр дүнгээр зудын жилүүдэд өрхийн орлого болон нийт малын тоо статистикийн хувьд мэдэгдэхүйц буурсан нь зудын шокийн анхны эмпирик нотолгоо болов. Correlated Random Effects (CRE/Mundlak) загвараар бусад хүчин зүйлсийг хянасны дараах үнэлгээ нь зудын хам нөлөөт шок өрхийн орлогод хамгийн хүчтэй, тогтвортой сөрөг нөлөө үзүүлдэг болохыг баталсан. Харин хувь өрхийн түвшний шок болох малын хорогдлын нөлөө нь өрхийн мал аж ахуйн цар хүрээ, суурь орлого, амьжиргааны бүтэц зэргээс хамааран илүү хэлбэлзэлтэй илэрч, мал аж ахуйд бүрэн түшиглэсэн өрхүүд зудын үед илүү эмзэг байгааг interaction хувьсагчид нотлов.

Судалгааны үр дүн нь зудын хам нөлөөт шок нь өрхийн дотоод хамгаалалтын механизмд зөөлрөх боломжгүй, макро түвшний хүчтэй эрсдэл болохыг харуулж, мал аж ахуйд суурилсан өрхийн амьжиргааг цаг уурын эрсдэлд өндөр өртөмтгий болгодгийг илтгэв. Бодлогын хувьд зудын хам нөлөөт шокийн эсрэг институцийн түвшний эрсдэлийн хамгаалалт шаардлагатай бөгөөд олон улсын туршлагаар үр ашигтайд тооцогддог Малын индексжүүлсэн даатгал (Index-Based Livestock Insurance) зэрэг бодлогын хэрэгслийг өргөжүүлэх, хүртээмжийг нэмэгдүүлэх нь зудын дараах орлогын уналтыг зөөлрүүлэхэд чухал ач холбогдолтой. Мөн бэлчээрийн чанар, санхүүгийн нөөц, өрхийн дотоод стратеги зэрэг нэмэлт хувьсагч бүхий урт хугацааны панел өгөгдөл ашиглан зудын нөлөөллийн механизмыг илүү нарийвчлан судлах шаардлагатай байна.

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Abstract

This study examines the effects of covariate (dzud) and idiosyncratic (household-level livestock loss) shocks on herder household income using a 3-year panel dataset of 56 households from Khotont soum, Arkhangai aimag (1999–2001). A non–parametric Kruskal–Wallis test provides initial evidence that both household income and total livestock holdings declined significantly during dzud years. Controlling for household characteristics, estimates from the Correlated Random Effects (Mundlak) model show that the covariate, the dzud shock, exerts the strongest and most significant negative impact on income. In contrast, the effect of idiosyncratic livestock loss varies widely across households, depending on herd size, baseline income, and livelihood structure, with interaction terms indicating that livestock-dependent households are particularly vulnerable during dzud events.

The findings confirm that dzud operates as a severe macro-level shock that cannot be mitigated through informal risk-sharing mechanisms, thereby exposing herder livelihoods to high climate-related vulnerability. From a policy perspective, institutional risk management instruments are essential for buffering covariate shocks. International experience highlights Index-Based Livestock Insurance (IBLI) as an effective tool for reducing dzud-related income losses; expanding its coverage and accessibility in Mongolia could strengthen household resilience. Future research would benefit from longer-term panel data, incorporating additional variables such as pasture quality, financial resources, and household coping strategies, to more precisely identify the mechanisms through which dzud affects rural livelihoods.

Түлхүүр үг: CRE; Mundlak; зуд; малчин өрхийн орлого; цаг уурын шок; панел өгөгдөл

JEL ангилал: C23; Q12; Q54; O13

Удиртгал

Монгол Улс нь жилийн дөрвөн улиралтай, өвлийн улиралд −50°C хүртэл хүйтэрдэг, эх газрын эрс тэс уур амьсгалтай орон бөгөөд хүн амын гуравны нэг орчим нь уламжлалт нүүдлийн мал аж ахуйд тулгуурласан амьжиргаатай. Малын ашиг шим нь малчин өрхийн орлогын гол эх үүсвэр тул байгалийн нөхцөл, цаг уурын өөрчлөлт нь өрхийн эдийн засгийн тогтвортой байдалд шууд нөлөөлдөг.

Хэдийгээр нүүдэлчин соёлтой малчин өрхүүд байгалийн хатуу ширүүн орчинд дасан зохицох уламжлалт аргатай ч нийгэм-эдийн засгийн өөрчлөлт, бэлчээрийн даацын доройтол, зах зээлийн эрсдэл зэрэг хүчин зүйлийн улмаас даван туулах чадавх нь суларч байна. Монголд давтамжтай тохиолддог ган, зуд зэрэг цаг уурын гамшигт үзэгдлүүд нь мал аж ахуйн үйлдвэрлэлд ноцтой хүндрэл учруулж, өрхийн эмзэг байдлыг нэмэгдүүлэхэд нөлөөлж байна (People in Need, 2020). Зуд нь их хэмжээний цас, хүйтэн, тэжээлийн хомсдол зэрэг олон хүчин зүйлийн хавсарсан нөлөөгөөр малын хорогдол огцом өсөх үзэгдэл бөгөөд байгалийн болон нийгэм-эдийн засгийн бусад эрсдэлтэй хавсарсан үед өрхийн түвшнээс эхлээд орон нутаг, үндэсний эдийн засагт хүртэл өргөн цар хүрээтэй үр дагавар үүсгэдэг. Жишээлбэл, 2000–2002 оны дараалсан зудын үед нийт 11.2 сая толгой мал хорогдсон нь (JICA, 2023) мал аж ахуйн салбарын эмзэг байдлыг тод харуулсан тохиолдол юм.

Зудын нөлөө бүх өрхөд ижил илэрдэггүй бөгөөд энэ нь хөгжлийн эдийн засгийн онолд өргөн хэрэглэгддэг эрсдэлийн ангилалтай нягт уялддаг. Эдийн засгийн онолд шокийг хам нөлөөт (covariate) болон хувь өрхийн (idiosyncratic) гэж ангилдаг бөгөөд эдгээрийн нөлөөллийн механизм эрс ялгаатай (Townsend, 1994; Deaton, 1991; Morduch, 1995). Хувь өрхийн шок нь орон нутгийн түвшний албан бус даатгалын сүлжээ, өрхийн хоорондын тусламж, зээл-тусламжийн сувгаар тодорхой хэмжээнд зөөлрөх боломжтой бол хам нөлөөт шок нь бүх өрхөд зэрэг нөлөөлдөг тул эдгээр хамгаалалтын механизм өөрөө шокод өртөж, орлого, хэрэглээ, хөрөнгийн хуримтлалын түвшинд илүү хүчтэй, тогтвортой, “даатгагдаагүй” нөлөө үзүүлдэг (Alderman & Paxson, 1994; Rosenzweig & Binswanger, 1993). Иймээс зуд нь онолын хувьд “даатгагдаагүй” хам нөлөөт шок бөгөөд өрхийн эдийн засагт илүү гүнзгий нөлөөлөх ёстой гэсэн хүлээлт бий. Энэ онолын суурь нь судалгааны үндсэн асуултыг тодорхойлох боломж олгож байна. Зудын хам нөлөөт шок нь өрхийн орлогод хувь өрхийн шокоос илүү хүчтэй нөлөөлөх ёстой юу, хэрэв тийм бол бодит өгөгдөл дээр энэ ялгаа хэрхэн илэрч байна вэ?

Энэхүү судалгаанд зудын өрхийн орлогод үзүүлэх нөлөөллийг Архангай аймгийн Хотонт сумын 56 малчин өрхийн 1999–2001 оны гурван жилийн панел өгөгдөл ашиглан үнэлэв. Судалгааны бүс болох Хотонт сум нь Хангайн нурууны зүүн урд хэсэгт байрлах, өвөлдөө −20°C, зундаа +16–аас +18°C дулаан, жилд 300–400 мм хур тунадас унадаг, бэлчээрийн мал аж ахуй давамгайлсан бүс юм. Тус суманд 2000 болон 2001 онд зуд тохиолдсон тул 1999 оны өгөгдөл зудгүй үеийг, 2000–2001 оны өгөгдөл зудтай үеийг илэрхийлж байгаа нь зудын өмнөх ба дараах орлогын өөрчлөлтийг панел өгөгдлийн хүрээнд харьцуулан шинжлэх боломж олгож байна.

Судлагдсан байдлын тоймд дурдсанчлан, олон улсын судалгаанууд уур амьсгалын шок нь зөвхөн орлогын дундаж түвшинд бус, орлогын тархалт, хөрөнгийн динамик, сэргэлтийн хурд, эрсдэлийн зан үйлийн өөрчлөлт зэрэг олон хэмжээсээр хүчтэй нөлөөлдөг болохыг тогтоосон (Dercon, 2004; Hoddinott, 2006; Jensen, 2000; Kazianga & Udry, 2006). Монголын нөхцөлд Kakinuma et al. (2024) зудын дараа орлогын тэгш бус байдал огцом нэмэгддэгийг харуулсан ч зудын нөлөөг хам нөлөөт болон хувь өрхийн шок болгон ялган шинжилсэн панел судалгаа ховор байна. Энэ нь зудын нөлөөллийн механизмыг өрхийн түвшинд нарийвчлан тодорхойлох шаардлагыг улам бүр нэмэгдүүлж байна.

Иймээс энэхүү судалгааны зорилго нь зудын хам нөлөөт шок (зуд тохиолдсон жилүүд) болон хувь өрхийн шок (малын хорогдлын хувь, өрхийн бэлтгэл, даван туулах чадавх зэрэг)-ийн орлогод үзүүлэх нөлөөг ялган тодорхойлох явдал юм. Судалгаанд дараах асуултуудад хариулна: 1) Зуд малчин өрхийн орлогод статистикийн хувьд ач холбогдол бүхий мэдэгдэхүйц нөлөө үзүүлсэн эсэх 2) Өрхийн түвшний шок буюу өвөлжилтийн бэлтгэл, даван туулах чадавх, малын хорогдол, санхүүгийн нөөц зэрэг хүчин зүйлс орлогын хэлбэлзлийн гол тайлбарлагч мөн эсэх.

Өгүүллийн бүтэц нь удиртгал хэсэгт зудын мөн чанар, судалгааны бүсийн онцлог болон малчин өрхийн амьжиргааны цаг уурын шокт өртөмтгий байдлыг онолын болон эмпирик үндэслэлээр тодорхойлж, зудын шокийн орлогод үзүүлэх нөлөөг панел өгөгдлөөр үнэлэх шаардлагыг дэвшүүлснээр эхэлж, дараагийн хэсэгт холбогдох өмнөх судалгааг тоймлон, улмаар өгөгдөл, арга зүй, үнэлгээний үр дүнг танилцуулан, эцэст нь гол дүгнэлт, зөвлөмжийг нэгтгэн харуулна.

Судлагдсан байдлын тойм

Уур амьсгалын гаралтай хам нөлөөт шок болох ган, зуд зэрэг үзэгдэл нь мал аж ахуй давамгайлсан бүс нутгуудад өрхийн орлого, хэрэглээ, хөрөнгийн хуримтлалд хүчтэй нөлөөлдөг болохыг олон улсын судалгаанууд тогтоосон. Эдийн засгийн онолын түвшинд Townsend (1994), Deaton (1991), Morduch (1995), Dercon (2004) нарын сонгодог бүтээлүүд өрхийн түвшний эрсдэл хуваалцах механизмын үндсэн зарчмыг тодорхойлсон байдаг. Эдгээр судалгаагаар хувь өрхийн шок нь тухайн бүс нутгийн албан бус даатгалын сүлжээ, харилцан туслалцах механизм, өрхийн хоорондын зээл-тусламжийн сувгаар тодорхой хэмжээнд зөөлрөх боломжтой бол хам нөлөөт шок нь бүх өрхөд зэрэг нөлөөлдөг тул дотоод даатгалын механизм бүрэн ажиллах боломжгүй, улмаар орлого, хэрэглээ, хөрөнгийн түвшинд илүү хүчтэй, тогтвортой сөрөг нөлөө үзүүлдэг болохыг нотолсон. Энэ хүрээнд Alderman & Paxson (1994), Rosenzweig & Binswanger (1993) зэрэг судалгаанууд цаг уурын эрсдэлийн үед өрхийн хэрэглээ болон хөрөнгийн бүтцийн өөрчлөлт хэрхэн явагддагийг онол–эмпирикийн түвшинд баталгаажуулсан. Энэ онолын үр дүн нь зудын нөлөөг өрхийн түвшинд хам нөлөөт болон хувь өрхийн шок болгон ялган шинжлэх шаардлагыг онолын хувьд зайлшгүй болгодог.

Эмпирик судалгааг ерөнхийд нь гурван чиглэлд хуваан авч үзэж болно. Нэгдүгээрт, уур амьсгалын шокийн эдийн засгийн нөлөөг судалсан ажилд хам нөлөөт болон хувь өрхийн шокийн ялгааг тодруулах нь гол зорилго байдаг. Van Dillen (2008) Энэтхэгийн ган гачигт өртөмтгий бүсийн панел өгөгдлөөр хам нөлөөт болон хувь өрхийн шокийн харьцангуй нөлөөг үнэлэхэд өрхийн түвшний шок орлогын хэлбэлзлийн гол эх үүсвэр болдгийг харуулсан. Skoufias & Vinha (2012) Мексикийн MxFLS өгөгдлөөр хур тунадас, температурын шок нь өрхийн хэрэглээнд мэдэгдэхүйц нөлөөлдөг бөгөөд нөлөөллийн хэмжээ нь бүс нутгийн цаг уурын онцлог, улирлын мөчлөгөөс хамааран ялгаатайг тогтоосон. Африкийн нөхцөлд Dercon (2004), Hoddinott (2006) зэрэг судалгаанууд уур амьсгалын шок нь орлого, хөрөнгийн хуримтлал, хүнсний хэрэглээнд хүчтэй нөлөөлдөг болохыг нотолсон. Мөн Jensen (2000), Kazianga & Udry (2006) зэрэг судалгаанууд хур тунадасны хэлбэлзэл, ган зэрэг шок нь хэрэглээ зөөлрүүлэх механизмд хэрхэн нөлөөлдгийг нарийвчлан харуулсан. Сүүлийн үеийн бүс нутгийн судалгаанууд зудын шок нь өрхийн түвшний нөлөөллөөс давж, макро эдийн засгийн хэмжээнд хүчтэй доргилт үүсгэдгийг онцолж байна. CAREC Institute-ийн QEM19 тайланд (2026) Монгол Улсад тохиолдсон зудын улмаас малын хорогдол огцом өсөж, мал аж ахуйн салбарын орлого болон бүс нутгийн эдийн засгийн идэвх мэдэгдэхүйц буурсан нь зудын хам нөлөөт шокийн макро шинжийг баталсан. Тайлан мөн зудын дараах өрхийн орлогын

уналт, амьжиргааны доройтол, жижиг малчдын эмзэг байдлын нэмэгдлийг онцолж, зудын шок нь өрхийн дотоод хамгаалалтын механизмаар зөөлрөх боломжгүй хүчтэй шок болохыг харуулсан. Эдгээр үр дүн нь зудын хам нөлөөт шок өрхийн орлогод тогтвортой сөрөг нөлөөтэй гэсэн энэхүү судалгааны онолын хүлээлттэй нийцэж байна.

Хоёрдугаарт, өрхийн эмзэг байдал ба эрсдэлийн менежментийн судалгаанд шокийн өмнөх ба дараах нөхцөл байдлын ялгааг тодруулахад төвлөрдөг. Shehu (2015) Нигерийн фермер өрхүүдийн үндэсний түвшинд төлөөлөх өгөгдлөөр хам нөлөөт болон хувь өрхийн шокийн хэрэглээнд үзүүлэх нөлөөг үнэлэхэд үнийн шок хамгийн хүчтэй нөлөөтэй, ядуу өрхүүд байгалийн болон эдийн засгийн шокт илүү эмзэг болохыг тогтоосон. Монголын нөхцөлд Altansukh нар (2023) нүүдэлчдийн амьжиргааны эмзэг байдлыг SLA болон LVI аргаар үнэлж, усны нөөц, бэлчээрийн доройтол, зах зээлийн хүртээмж зэрэг хүчин зүйлс нь цаг уурын шокийн үед өрхийн эмзэг байдлыг нэмэгдүүлдгийг харуулсан. Barrett & Carter (2006), Janzen & Carter (2013) зэрэг судалгаанууд шокийн дараах сэргэлт нь хөрөнгийн түвшнээс хамааран эрс ялгаатай, ядуурлын урхинд унах эрсдэлтэйг онцолсон. Монголын нөхцөлд Fernández-Giménez (1999, 2002) болон Sternberg (2010) нарын судалгаанууд зудын эрсдэлийн макро түвшний шалтгаан, бэлчээрийн доройтол, нүүдлийн зохион байгуулалтын өөрчлөлтийг тодорхойлсон ч өрхийн түвшний динамик нөлөөллийг эмпирик байдлаар нарийвчлан судлаагүй байна.

Гуравдугаарт, панел өгөгдөлд суурилсан динамик шинжилгээ нь шокийн богино болон дунд хугацааны нөлөөг илүү нарийвчлан шинжлэх боломж олгодог. McPeak (2004), Carter & Barrett (2006) нарын судалгаанууд малын хорогдол, хөрөнгийн түвшин нь шокийн дараах сэргэлтийн хурд, ядуурлын урхинд унах эрсдэлтэй хэрхэн уялддагийг харуулсан. Монголын нөхцөлд Kakinuma нар (2024) 2004–2013 оны 787 өрхийн панел өгөгдлөөр 2009 оны зуд нь орлогын дундаж түвшнээс гадна орлогын тархалт, тэгш бус байдалд хүчтэй нөлөөлдөг бөгөөд малын хорогдол өндөртэй өрхүүд зудын дараах сэргэлтэд хүрч чаддаггүйг тогтоосон. Мөн Lybbert нарын (2004) судалгаа мал аж ахуйд суурилсан өрхийн хөрөнгийн динамик нь шокийн дараах сэргэлтэд хэрхэн “asset threshold” буюу хөрөнгийн босго үүсгэдгийг харуулсан нь зудын дараах сэргэлтийн механизмтай онол–эмпирикийн хувьд нийцэж байна.

Дээрх судалгаануудын нийтлэг үр дүн нь уур амьсгалын шокийн нөлөө нь өрхийн хөрөнгийн түвшин, байршил, зах зээлийн хүртээмж, дасан зохицох чадвараас хамааран эрс ялгаатай илэрдэг бөгөөд шокийн дараах сэргэлт нь бүх өрхөд ижил бус гэдгийг

харуулдаг. Гэвч Монголын нөхцөлд зудын нөлөөллийг өрхийн түвшний панел өгөгдлөөр, хам нөлөөт болон хувь өрхийн шокийг ялган хэмжсэн эмпирик судалгаа бараг байхгүй. Өмнөх судалгаануудын ихэнх нь макро түвшний малын хорогдлын статистик, эмзэг байдлын индекс, эсвэл нэг удаагийн cross-sectional өгөгдөлд тулгуурласан байдаг. Иймээс зудын өмнөх ба зудын үеийн богино хугацааны динамик өөрчлөлтийг өрхийн түвшинд нарийвчлан хэмжих, шокийн төрлүүдийн ялгааг панел регрессийн аргачлалаар үнэлэх шаардлага үүсэж байна.

Энэхүү судалгаа нь дээрх цоорхойг нөхөх зорилготой бөгөөд (i) зудын хам нөлөөт болон өрхийн түвшний шокийн нөлөөг гурван жилийн панел өгөгдлөөр ялган үнэлж, (ii) CRE/Mundlak загварыг ашиглан өрхийн тогтвортой ялгааг хянаж, зудын нөлөөллийн механизмыг онол–эмпирикийн баталгааг сайжруулж, (iii) зудын өмнөх ба зудын үеийн богино хугацааны динамик өөрчлөлтийг тоон байдлаар хэмжсэнээр энэхүү кейс судалгааны хүрээнд малчин өрхийн эмзэг байдлын механизмын талаарх эмпирик цоорхойг нөхөж байна.

Өгөгдөл болон Арга зүй

Энэхүү судалгаанд Архангай аймгийн Хотонт сумын 56 өрхийн 1999–2001 оны гурван жилийн панел өгөгдөл (нийт 168 ажиглалт) ашиглав. Өгөгдлийг YCX-ны 1998 оны Амьжиргааны түвшний түүвэр судалгааны мэдээлэлд тулгуурлан, Германы Ruprecht-Karls Universität Heidelberg-ийн судлаачдаар ахлуулсан баг 2000, 2001 оны намрын улиралд цуглуулсан. Архангай аймаг, Хотонт сум нь 1999/2000 болон 2000/2001 оны зудын нөлөөнд хүчтэй өртсөн (United Nations OCHA, 2001) бүс нутгийн нэг байсан тул зудын шокийн өрхийн орлогод үзүүлэх нөлөөллийг судлахад тохиромжтой талбар болж байна.

Судалгаанд хамрагдсан 56 өрхийг HS2000 судалгааны хүрээнд Хотонт сумын нутаг дэвсгэрт өргөн талбайг хамруулах байдлаар, сумын удирдлагуудтай зөвлөлдөн, малчин өрхүүдийн дундаас энгийн санамсаргүй түүврийн аргаар сонгосон. Ийм түүвэрлэлт нь сумын доторх байршлын болон мал аж ахуйн нөхцөлийн ялгааг тодорхой хэмжээнд тусган авч, өрхийн түвшний өгөгдлийн дотоод хүчинтэй байдлыг хангах зорилготой байв. Харин судалгааны талбар болох Хотонт сумыг зориуд сонгосон нь тухайн бүс нутаг зудын нөлөөг хүчтэй хүлээн авсан бүс нутгийн онцлогийг тусгасан ч ийм зорилтот сонголт (location selection) нь өгөгдлийн үндэсний түвшний төлөөлөх чадварыг хязгаарлах хүчин зүйл болдог.

Өгөгдөл зөвхөн нэг сумын хүрээнд цугларсан нь судалгааны арга зүйн хувьд хэд хэдэн онцлог хязгаарлалттай. Нэгдүгээрт, газарзүйн хувьд ойр байрлалтай өрхүүд бэлчээрийн чанар, цаг уурын нөхцөл, зах зээлийн хүртээмж, нийгэм-эдийн засгийн орчин зэрэг олон талын төстэй хүчин зүйлсийг хуваалцдаг тул ажиглалт хоорондын spatial autocorrelation үүсэх магадлалтай. Энэ нь стандарт алдааг дутуу үнэлэх, улмаар параметрийн статистик ач холбогдлыг хэтрүүлэн үнэлэх эрсдэлтэй. Иймээс үнэлгээнд өрхийн түвшинд кластерлэсэн стандарт алдаа (cluster-robust standard errors) ашиглаж, өрхийн доторх автокорреляц болон heteroskedasticity-г засварлан, үнэлгээний найдвартай байдлыг хангах арга зүйг хэрэглэв.

Хоёрдугаарт, панел өгөгдлийн чанарт нөлөөлөх гол эрсдэл болох attrition буюу өрхийн судалгаанаас гаралт үүсэх эрсдэлтэй. Судалгааны баг малчдыг нүүсэн газарт нь очиж ярилцлага авсан тул өрхүүд судалгаанаас санамсаргүй болон системтэй гараагүй. Иймээс панел өгөгдөл баланстай, attrition-тай холбоотой sample selection bias үүсэх магадлал маш бага гэж үзэж болно.

Гуравдугаарт, судалгааны талбар болох Хотонт сумыг зориуд сонгосон нь зудын нөлөөг хүчтэй хүлээн авсан бүс нутгийн онцлогийг тусгасан ч ийм сонголт нь өгөгдлийн үндэсний түвшний төлөөлөх чадварыг хязгаарладаг. Иймээс энэхүү өгөгдөл нь Монголын бүх малчин өрхийг төлөөлөх зорилготой бус, харин зудын нөлөөллийн механизмыг нарийвчлан шинжлэх, өрхийн түвшний шокийн ялгаатай илрэл, эмзэг байдлын бүтэц, орлогын динамикийг гүнзгийрүүлэн судлахад чиглэсэн кейс судалгаа гэж үзэх нь зүйтэй. Энэ нь судалгааны үр дүнг макро түвшний ерөнхий дүгнэлт болгон тайлбарлах бус, харин зудын үед өрхийн орлого хэрхэн өөрчлөгдөх механизм, шок дамжих суваг, өрхийн дасан зохицох стратегийг илүү нарийвчлан тодорхойлох боломжийг олгодог.

Өрхийн орлогын динамикийг судлахад панел өгөгдөл ашиглах нь өрхийн тогтвортой, ажиглагдаагүй ялгааг хянах боломж олгодог боловч гол хүндрэл нь өрхийн тогтвортой нөлөө u_i болон тайлбарлагч хувьсагчид X_{it} хоорондын хамаарал юм. Хэрэв ийм хамаарал байвал Random Effects (RE) загварын үндсэн таамаглал $cov(u_i, X_{it}) = 0$ зөрчигдөж, үнэлгээ тогтворгүй болох эрсдэлтэй. Fixed Effects (FE) загвар тогтвортой үнэлгээ өгдөг ч цаг хугацааны хам нөлөөт шок (зудын жилүүд)-ийн нөлөөг (өрхийн доторх хэлбэлзэлгүй тул) үнэлж чадахгүй. Өөрөөр хэлбэл, FE загвар нь хам нөлөөт шокийн нөлөөг онолын хувьд танигдах боломжгүй болгодог (Wooldridge, 2010).

Эдгээр онол-арга зүйн хязгаарлалтыг даван туулах хамгийн оновчтой арга нь Correlated Random Effects (CRE) буюу Mundlak (1978) загвар юм. Mundlak-ийн хандлагаар u_i болон X_{it}хоорондын хамаарлыг тухайн өрхийн хугацааны дундаж хувьсагч $\bar{X}_i$-аар дамжуулан илэрхийлж, RE загварын таамаглалыг зөрчихгүйгээр тогтвортой үнэлгээ авах боломж бүрддэг. CRE загварын үндсэн хэлбэр:

$$Y_{it} = X_{it}\beta + \bar{X}_i\theta + u_i + \varepsilon_{it} \qquad (1)$$

Энд

$\bar{X}_i$ - тухайн өрхийн бүх хугацаанд ажиглагдсан X_{it} хувьсагчдын хугацааны дундаж (Mundlak-ийн дундаж)

θ- бүлэг хоорондын хэлбэлзлийн нөлөөг илэрхийлэх коэффициент

CRE загвар нь (i) FE загварын адил өрхийн тогтвортой ялгааг хянах, (ii) RE загварын адил цаг хугацааны dummy хувьсагчдыг (zud2000, zud2001) үнэлэх боломжийг хадгалах, (iii) RE-ийн таамаглал зөрчигдөхөөс сэргийлж тогтвортой үнэлгээ өгөх, (iv) бүлэг доторх болон бүлэг хоорондын нөлөөг ялган тодорхойлох давуу талтай. Иймээс зудын хам нөлөөт шокийг үнэлэхэд CRE загвар онол-эмпирикийн хувьд хамгийн тохиромжтой юм.

Энэхүү судалгаанд ашигласан CRE загвар дараах байдлаар тодорхойлогдоно:

$$\ln(hh_{income_{it}}) = \beta_1 hhsize_{it} + \beta_2 childnum_{it} + \beta_3 livestock_{it}$$

$$+\beta_4 lost2000_{it} + \beta_5 lost2001_{it} + \beta_6 lost2000_{occ_{it}} + \beta_7 lost2001_{occ_{it}} + \beta_8 \ln\_asset_{it}$$

$$+\gamma_1 zud2000_t + \gamma_2 zud2001_t + \theta_1 mean_{hhsize_i} + \theta_2 mean_{childnum_i} + \theta_3 mean_{livestock_i}$$

$$+\delta_1 Soum_{km_i} + \delta_2 Aimag_{km_i} + \delta_1 MainM_{km_i} + \delta_4 Heating_i + \delta_5 Occup_i + u_i + \varepsilon_{it} \qquad (2)$$

Энд:

Хамааран хувьсагч $\ln(hh_{income_{it}})$ нь өрхийн нийт бодит орлогын логарифм юм. Зудын хам нөлөөт шокийг *zud2000* болон *zud2001* dummy хувьсагчдаар илэрхийлсэн бөгөөд эдгээр нь бүх өрхөд зэрэгцэн нөлөөлөх тул covariate shock гэж үзэж, орлогод сөрөг нөлөөтэй гэж таамаглав. Харин өрх бүрийн малын хорогдлын хувь болох $lost2000_{it}, lost2001_{it}$ нь өрх бүрт харилцан адилгүй нөлөөлөх idiosyncratic shock бөгөөд мөн сөрөг нөлөөтэй байх хүлээлттэй. Малчин өрхийн эмзэг байдлыг шалгах $lost2000_{occ_{it}}, lost2001_{occ_{it}}$ interaction хувьсагчид нь зудын үед малчин өрхүүдийн орлого илүү хүчтэй буурдаг эсэхийг илрүүлэх зорилготой. Өрхийн бүтэцтэй холбоотой

хувьсагчдаас $hhsize_{it}$ буюу ам бүлийн тоо нь хөдөлмөрийн нөөцийг нэмэгдүүлэх (+) болон хэрэглээний дарамтыг өсгөх (–) хоёрдмол нөлөөтэй, $childnum_{it}$ буюу хүүхдийн тоо орлогод хоёрдмол, харин нийт малын тоо $livestock_{it}$ болон хөрөнгийн хэмжээ $\ln\_asset_{it}$ нь эерэг нөлөөтэй гэж үзэв. Байршлын хувьсагчид $Soum_{km_i}, Aimag_{km_i}, MainM_{km_i}$ (сум, аймаг, гол зах зээл хүртэлх зай) нь зах зээлийн хүртээмжийг бууруулдаг тул орлогод сөрөг нөлөөтэй. Өрхийн тогтмол шинжүүд болох $Heating_i$ (жилийн турш түлэх түлшний нөөц хангалттай эсэх) болон $Occup_i$ (өрхийн тэргүүн малчин эсэх) нь амьжиргааны түвшин болон орлоготой эерэг хамааралтай гэж таамаглав. CRE загварт багтсан Mundlak-ийн дундаж хувьсагчид ($mean_{hhsize_i}$, $mean_{childnum_i}$, $mean_{livestock_i}$) нь өрх хоорондын тогтвортой ялгааг барьж, RE таамаглал зөрчигдөхөөс сэргийлэх үүрэгтэй. Алдааны гишүүд нь өрхийн хугацааны хувьд тогтвортой боловч ажиглагдаагүй санамсаргүй нөлөө (u_i) болон хугацааны хувьд өөрчлөгдөх санамсаргүй алдаа (ε_{it}) юм.

Загварт орсон зарим тайлбарлагч хувьсагчид (жишээлбэл, нийт малын тоо, хөрөнгийн хэмжээ) нь орлоготой зэрэгцэн тодорхойлогдох магадлалтай тул эндоген байдлын эх үүсвэр болж болзошгүй. Энэ нь орлого, хөрөнгө, орлого гэсэн давталттай механизм үүсгэж reverse causality бий болгох бөгөөд мөн өрхийн ажиглагдаагүй шинжүүдээс шалтгаалах omitted variable bias-ийг үүсгэнэ (Angrist & Pischke, 2009). Эдгээр хүчин зүйлс нь коэффициентуудыг гажуудуулах эрсдэлтэй.

Судалгаанд ашигласан панел өгөгдлийн хугацааны цар хүрээ (T = 3) богино тул лаг хувьсагч ашиглах, эсвэл гадны хүчин зүйлд суурилсан найдвартай instrumental variable тодорхойлох боломж хязгаарлагдмал байна. CRE/Mundlak загвар нь өрхийн тогтвортой, ажиглагдаагүй ялгааг хугацааны дундаж хувьсагчдаар дамжуулан хянаж, unobserved heterogeneity-гээс үүдэх эндоген байдлын эрсдэлийг тодорхой хэмжээнд бууруулж байгаа ч зэрэгцээ тодорхойлогдох байдлыг бүрэн арилгах боломжгүй. Иймээс эдгээр хувьсагчдын коэффициентуудыг шалтгаант бус, зөвхөн нөхцөлт хамаарлын түвшинд тайлбарлах нь зүйтэй.

Харин зудын dummy хувьсагчид (zud2000, zud2001) өрхийн зан төлөв, шийдвэрээс үл хамаарах цаг уурын шок тул экзоген шинжтэй. Иймээс судалгааны гол зорилго болох зудын хам нөлөөт шокийн орлогод үзүүлэх нөлөөг шалтгаант дүгнэлт хийх боломжтой хэвээр гэж үзэв.

Хүснэгт 1-д судалгаанд ашигласан 168 ажиглалтаас бүрдэх өрхийн панел өгөгдлийн үндсэн статистик шинжүүдийг нэгтгэн үзүүлэв.

Хүснэгт 1. Тайлбарлах статистик

Хувьсагч	Obs	Mean	Std. dev.	Min	Max
Өрхийн нийт бодит орлогын логарифм	168	13.312	0.843	10.912	15.251
Ам бүлийн тоо	168	5.179	2.031	1	15
Хүүхдийн тоо	168	2.185	1.413	0	6
Малын тоо	168	117.131	109.148	0	780
2000 оны зудад алдсан малын тоо/2000 оны 9-р сард байгаа малын тоо	168	0.212	0.672	0	6.346
2001 оны зуданд алдсан малын тоо/2001 оны 9-р сард байгаа малын тоо	168	0.258	0.587	0	3.720
lost2000 × малчин өрх эсэх дамми (малчин өрхийн 2000 оны зудын үед хорогдлын нэмэлт нөлөө)	168	0.177	0.633	0	6.346
lost2001 × малчин өрх эсэх дамми (малчин өрхийн 2001 оны зудын үед хорогдлын нэмэлт нөлөө)	168	0.205	0.530	0	3.720
Өрхийн хөрөнгийн логарифм	168	14.885	1.066	11.695	17.305
2000 оны зудын дамми	168	0.333	0.473	0	1
2001 оны зудын дамми	168	0.333	0.473	0	1
Өрхийн ам бүлийн тооны хугацааны дундаж (Mundlak)	168	5.179	1.962	1	14
Хүүхдийн тооны хугацааны дундаж (Mundlak)	168	2.185	1.375	0	5.333
Малын тооны хугацааны дундаж (Mundlak)	168	117.131	103.406	17.667	646
Сумын төв хүртэлх зай, км	168	11.304	9.854	0	30
Аймгийн төв хүртэлх зай, км	168	83.536	38.866	0	167
Үндсэн зах зээлээс алслагдсан зай, км	168	39.768	78.774	0	415
Жилийн турш түлэх түлшний нөөц хангалттай эсэх дамми	168	0.750	0.434	0	1
Малчин өрх эсэх дамми	168	0.839	0.368	0	1

Эх сурвалж: Судлаачийн тооцоо

Орлогын тархалтын хазайлт болон хэт утгуудын нөлөөг бууруулах зорилгоор орлогын логарифмчилсан утгыг ашигласан. Логарифмчилсан орлогод IQR аргачлалаар outlier шинжилгээ хийхэд хэт өндөр эсвэл хэт бага утга илрээгүй бөгөөд тархалтын үзүүлэлтүүд (skewness = 0.066, kurtosis = 2.68) нь лог орлого хэвийн тархалттай ойролцоо байгааг харуулсан (Хавсралт 1). Иймээс орлогын хувьсагчийг нэмэлт засвар (winsorizing) хийх шаардлагагүй гэж үзсэн.

Өгөгдлийн хязгаарлалтаас шалтгаалан орлогын зарим бүрэлдэхүүн хэсэг дутуу мэдээлэлтэй байсан ч нийт бодит орлогын үзүүлэлт нь бүх өрхөд бүрэн байгаа тул судалгаанд ашигласан. Өрхийн бодит орлогын логарифм дунджаар 13.31, стандарт хазайлт 0.84 байгаа нь орлогын түвшин өрхүүдийн хооронд мэдэгдэхүйц ялгаатайг илтгэнэ. Өрхийн ам бүлийн тоо дунджаар 5, хүүхдийн тоо дунджаар 2 байна. Нэг өрхөд

ногдох малын тооны дундаж 117 бөгөөд малын тооны өндөр хэлбэлзэл (109) нь хөрөнгийн төвлөрөл, мал аж ахуйн ялгааг илтгэнэ.

2000 болон 2001 оны зудын үеийн малын хорогдлын хувь нь өвөл хорогдсон малын тоог тухайн жилийн 9-р сард үлдсэн малын тоонд харьцуулсан үзүүлэлт бөгөөд хүснэгтээс харахад дундаж хорогдлын хувь 0.21–0.26 орчим байна. Гэвч стандарт хазайлт өндөр байгаа нь зудын нөлөө өрхүүдийн хооронд маш харилцан адилгүй илэрснийг харуулж байна. Зарим өрхөд хорогдлын хувь 1-ээс давсан нь хэмжилтийн алдаа бус бөгөөд зудын үед тохиолддог ‘herd collapse’ буюу өвлийн туршид малын тоо огцом буурч, 9-р сарын үлдэгдэл малын тоо маш бага болдог үзэгдэлтэй нийцдэг. Судалгаанд өвлийн эхний малын тоо байхгүй тул denominator-т зөвхөн 9-р сарын үлдэгдэл малын тоог ашигласан нь хорогдлын хувь 1-ээс давж харагдах арга зүйн онцлогийг бий болгож байна.

Малчин өрхүүдийн хувьд (lost2000_occ, lost2001_occ) хорогдлын хувьсагчийн стандарт хазайлт харьцангуй өндөр байгаа нь зудын үед мал аж ахуйд түшиглэсэн өрхүүдийн эмзэг байдал илүү өндөр, хариу үйлдэл нь илүү хэлбэлзэлтэй байсныг илтгэнэ. Энэ нь зудын нөлөө мал аж ахуйд төвлөрсөн өрхүүдэд илүү хүчтэй, илүү хувьсагч хооронд ялгаатай илэрдэг болохыг харуулж байна.

Малчин өрхүүдийн хувьд (lost2000_occ, lost2001_occ) малын хорогдлын хувь илүү өндөр хэлбэлзэлтэй байгаа нь зудын үед мал аж ахуйд түшиглэсэн өрхүүдийн эмзэг байдал илүү өндөр болохыг илтгэнэ.

Өрхийн санхүүгийн нөөц болон эрсдэлийн эсрэг хамгаалах чадамжийг илэрхийлдэг хөрөнгийн логарифм (ln_asset) нь дунджаар 14.89, стандарт хазайлт 1.07-той байгаа нь хөрөнгийн түвшин өрхүүдийн хооронд мэдэгдэхүйц ялгаатай байгааг харуулж байна. Байршлын хувьсагчдаас сумын төв хүртэлх зай 11.3 км, аймгийн төв хүртэлх зай 83.5 км, гол зах зээл хүртэлх зай 39.8 км бөгөөд эдгээрийн өндөр хэлбэлзэл нь зах зээлийн хүртээмжийн ялгааг илэрхийлж байна.

Heating хувьсагчийн дундаж утга 0.75 буюу өрхүүдийн 75% нь жилийн турш түлэх түлшний нөөц хангалттай, тогтмол халаалттай байсныг илтгэж байна. Харин Occup хувьсагчийн дундаж утга 0.84 буюу өрхүүдийн 84% нь мал аж ахуйг үндсэн амьжиргааны эх үүсвэр болгож буйг харуулна. Mundlak-ийн дундаж хувьсагчид (mean_hhsize, mean_childnum, mean_livestock) нь өрх хоорондын тогтвортой бүтцийн ялгааг илэрхийлж, панел өгөгдлийн between-variation-ийг баталгаажуулж байна.

Үнэлгээний үр дүн

Зудын өмнөх болон зудын жилүүдийн өрхийн бодит орлого, нийт малын тоо статистик ач холбогдол бүхий ялгаа байгаа эсэхийг параметрийн бус Kruskal–Wallis шинжүүрээр шалгаж, үр дүнг Хүснэгт 2-т харуулав. Шинжүүрийн үр дүнгээс харвал 1999, 2000, 2001 онуудын өрхийн орлогын тархалтууд статистик ач холбогдол бүхий ялгаатай (χ^2(2)=19.76, p=0.0001) бөгөөд энэ нь зудын жилүүдэд өрхийн орлого мэдэгдэхүйц буурсан анхны нотолгоо юм. Нийт малын тооны хувьд мөн χ^2(2)=11.28, p=0.0036 үр дүн гарсан нь зудын жилүүдэд малын тоо огцом, статистик ач холбогдол бүхий буурсан болохыг харуулж байна.

Хүснэгт 2. Kruskal–Wallis шинжүүрийн үр дүн

Он	Ажиглалтын тоо	Ранкийн нийлбэр	
		Бодит орлого	Малын тоо
1999	56	5942	5663.5
2000	56	4586	4577
2001	56	3668	3955.5
chi2(2)		19.755	11.281
Prob		0.0001	0.0036
chi2(2) with ties		19.756	11.282
Prob		0.0001	0.0035

Эх сурвалж: Судлаачийн тооцоо

Kruskal–Wallis шинжилгээний дүн нь зудын жилүүдэд өрхийн бодит орлого болон малын тоо мэдэгдэхүйц буурсан болохыг анхны нотолгоогоор харуулж байна. Гэвч эдгээр өөрчлөлт нь зөвхөн зудын шууд нөлөө мөн эсэх, эсвэл өрхийн бүтэц, хөрөнгө, байршил зэрэг бусад хүчин зүйлсийн нөлөөтэй хавсарсан эсэхийг ялган тогтоох боломжгүй. Иймээс зудын хам нөлөөт болон хувь өрхийн шок, өрхийн бүтэц, хөрөнгө, байршлын шинжүүдийн нөлөөг зэрэг хянасан CRE (Mundlak) загварын үнэлгээг ашиглан шалтгаант нөлөөллийг илүү нарийвчлан шинжиллээ.

Хүснэгт 3-т зудын шокийн өрхийн бодит орлогод үзүүлэх нөлөөг RE, FE болон CRE (Mundlak) загвараар үнэлсэн үнэлгээний үр дүнг харуулав. Хүснэгт 3-ын 3-р баганад үзүүлсэн CRE (Mundlak) загварын үр дүн нь зудын хам нөлөөт болон хувь өрхийн шок, өрхийн бүтэц, хөрөнгө, байршлын шинжүүдийн орлогын логарифмд үзүүлэх нөлөөг үнэлсэн бөгөөд загварын нийт Wald $\chi^2 = 85.46$ ($p < 0.001$) нь загвар бүхэлдээ статистикийн хувьд ач холбогдолтой болохыг харуулж байна. CRE загвар нь FE ба RE загварын давуу талыг хослуулж, өрхийн хоорондын ажиглагдаагүй ялгааг Mundlak-ийн

дундаж хувьсагчдаар хянаснаар зудын хам нөлөөт шокийн нөлөөг илүү найдвартай үнэлэх боломж олгож байна.

CRE загварт зудын хам нөлөөт шокоос zud2001 хувьсагчийн коэффициент –0.538 (p = 0.004) нь 2001 оны зуд өрхийн орлогыг дунджаар 42% бууруулсан хүчтэй, сөрөг нөлөөтэй шок байсныг нотолно. FE загварт мөн адил zud2001 хувьсагчийн коэффициент –0.587 (p < 0.01) гэсэн тогтвортой сөрөг нөлөө илэрсэн нь зудын шок өрхийн доторх орлогын динамикт ч хүчтэй нөлөөлснийг харуулна. RE загварт zud2001 хувьсагчийн коэффициент –0.429 (p = 0.07) гэсэн 10%-ийн түвшинд ач холбогдолтой боловч RE загварын үндсэн таамаглал болох $cov(u_i, X_{it}) = 0$ нь бодит нөхцөлд зөрчигдөх магадлалтай тул RE-ийн коэффициентыг шалтгаант дүгнэлт хийхэд болгоомжтой тайлбарлах шаардлагатай.

FE болон CRE загваруудад илэрсэн илүү хүчтэй, статистикийн хувьд ач холбогдолтой нөлөө нь zud2001 хувьсагчийн бодит шокийн нөлөөг илүү найдвартай илэрхийлж байна. CRE загвар нь Mundlak-ийн дундаж хувьсагчдаар өрхийн хоорондын ажиглагдаагүй ялгааг хянаснаар FE ба RE загварын давуу талыг хослуулж, зудын хам нөлөөт шокийн нөлөөг үнэлэхэд онол-эмпирикийн хувьд хамгийн тохиромжтой сонголт болж байна.

CRE загварт zud2000 хувьсагч ач холбогдолгүй гарсан нь зудын хүч сул байсан гэсэн дүгнэлт биш юм. Хорогдлын хувь нь өвөл хорогдсон малын тоог тухайн жилийн 9-р сарын үлдэгдэл малын тоонд харьцуулсан үзүүлэлт тул denominator-ийн тархалтын ялгаа коэффициентын статистикийн хүчинд нөлөөлөх боломжтой. Хавсралт 2-т харуулсан тархалтын шинжилгээний үр дүнгээс харахад 2001 онд үлдэгдэл малын тооны стандарт хазайлт 2000 оноос өндөр (SD=110.5 ба SD=91.7) байсан нь хорогдлын хувь өрхүүдийн хооронд илүү ялгаатай байсныг илтгэнэ. Иймээс zud2001 хувьсагчийн нөлөө CRE загварт илүү тодорхой илэрсэн бол 2000 онд denominator-ийн харьцангуй жигд тархалт нь zud2000 хувьсагчийн статистикийн хүчийг сулруулсан байж болох юм.

Хүснэгт 3. Зудын шокийн өрхийн бодит орлогод үзүүлэх нөлөө: RE, FE болон Correlated Random Effects (Mundlak) загварын үнэлгээ

	RE (1)	FE (2)	CRE (Mundlak) (3)
hhsize	0.069	0.049	0.096
child	0.260	-0.037	0.245
livestock	-0.000	-0.001*	-0.000
lost2000	0.129	0.372	0.323*
lost2001	-0.205	0.044	0.024
lost2000_occ	-0.358	-0.546*	-0.519***
lost2001_occ	-0.143	-0.247	-0.222
ln_asset	0.005	0.043	0.043
Soum_km	0.000	-0.009	-0.008
Aimag_km	0.000	0.000	0.000
MainM_km	0.000	-0.000	-0.000
Heating	0.000	0.015	0.003
Occup	0.000	0.299	0.301
zud2000	-0.266	-0.373**	-0.290
zud2001	-0.429*	-0.587***	-0.538***
mean_hhsize			-0.042
mean_childnum			-0.306
mean_livestock			-0.001
Constant	12.676***	12.817***	12.820***
Observations	168	168	168
sigma_u			0
sigma_e			0.817
rho			0
R2-within	0.212	0.185	0.203
R2-between	0.000	0.138	0.137
R2-overall	0.057	0.172	0.185
F/WaldChi2	2.75	31.55	85.46
Prob	0.005	0.007	0.000

Эх сурвалж: Судлаачийн тооцоо

Тэмдэглэл: Хүснэгтийн (1), (2), (3) багануудад харгалзан RE, FE, CRE(Mundlak) загварын коэффициентуудыг харуулав. *, **, *** нь тус бүр 10%, 5%, 1%-ийн түвшинд статистикийн ач холбогдолтойг илтгэнэ. Үнэлгээнд өрхийн түвшинд cluster-robust standard errors ашигласан. Hausman test (χ^2 = 5.48, p = 0.857) нь FE ба RE загварууд системтэй ялгаагүйг харуулсан тул CRE загвар онол-эмпирикийн хувьд илүү тохиромжтой гэж үзэв.

Хувь өрхийн шокийн хувьд lost2000 хувьсагчийн коэффициент CRE загварт эерэг, 10%-ийн түвшинд ач холбогдолтой гарсан нь малын хорогдол өндөртэй өрхүүд суурь орлого өндөртэй байх магадлалтай (selection effect) байж болохыг илтгэнэ. Малчин өрхийн эмзэг байдлыг илэрхийлэх interaction хувьсагчдын хувьд lost2000_occ хувьсагчийн коэффициент –0.519 (p=0.009) гарсан нь малчин өрхүүд зудын үед малын хорогдолд илүү

хүчтэй өртөж, орлогын уналт нь бусад өрхөөс илүү гүнзгий байсныг статистикийн хувьд баталж байна.

Өрхийн хөрөнгийн түвшин (ln_asset), өрхийн бүтцийн хувьсагчид (hhsize, child_num, livestock), мөн Mundlak-ийн дундаж хувьсагчид статистикийн хувьд ач холбогдолгүй гарсан нь эдгээр хүчин зүйлүүд зудын хүчтэй шокийн өмнө орлогын хэлбэлзлийг тайлбарлахад хангалтгүй байсныг илтгэнэ. Байршлын хувьсагчид болон Heating, Occup хувьсагчид мөн ач холбогдолгүй гарсан нь газарзүйн байрлал, халаалтын нөхцөл, мэргэжлийн ялгаа зэрэг нь зудын шокийн үед орлогын өөрчлөлтийг тайлбарлахад сул хүчин зүйл байсныг харуулж байна.

FE ба RE загварын харьцуулалт нь CRE загварын сонголтыг баталгаажуулсан. FE загварт зудын dummy хувьсагчид (zud2000, zud2001) статистикийн хувьд ач холбогдолтой гарсан нь зудын нөлөө өрхийн доторх орлогын өөрчлөлтөд хүчтэй илэрч байсныг харуулж байна. RE загвар зудын нөлөөг илрүүлсэн боловч RE-ийн үндсэн таамаглал болох $cov(u_i, X_{it}) = 0$ нь бодит нөхцөлд зөрчигдөх магадлалтай тул RE-ийн коэффициентыг шалтгаант дүгнэлт хийхэд болгоомжтой тайлбарлах шаардлагатай. Hausman тестийн үр дүн ($\chi^2 = 5.48$, $p = 0.857$) нь FE ба RE коэффициентууд системтэй ялгаагүйг харуулсан бөгөөд Mundlak-ийн дундаж хувьсагчид ач холбогдолтой гарсан нь өрхийн хоорондын ажиглагдаагүй ялгааг илүү зөв хянаж байгааг илэрхийлнэ. Иймээс CRE загвар онол-эмпирикийн хувьд хамгийн тохиромжтой сонголт болохыг бататгаж байна.

Зудын нөлөөллийн тогтвортой байдлыг шалгах үүднээс орлогын оронд малын тооны өөрчлөлт (Δlivestock)-ийг хамаарах хувьсагч болгон ашигласан нэмэлт шинжилгээг хийв (Хавсралт 3). Үр дүнгээс харахад zud2000 хувьсагч бүх загварт (FE, RE, CRE) тогтвортойгоор хүчтэй сөрөг нөлөөтэй гарсан нь 2000 оны зудын шок зөвхөн орлогын түвшинд бус, өрхийн хөрөнгийн динамикт ч хүчтэй илэрч байгааг батална. Харин zud2001 хувьсагч Δlivestock загварт техникийн хувьд үнэлэгдэх боломжгүй байсан нь 2001 онд зудын дараах үлдэгдэл малын тархалт өрхүүдийн хооронд маш өндөр хэлбэлзэлтэй байсан, зарим өрхөд мал бараг бүрэн хорогдсон зэрэг өгөгдлийн бүтэцтэй холбоотой байж болох юм. Энэ нь зудын нөлөө орлогын загварт илүү тодорхой илэрсэн шалтгааныг тайлбарлаж байна. Малын тооны өөрчлөлтийн шинжилгээнд малын хорогдлын interaction хувьсагчид (lost2000_occ, lost2001_occ) CRE загварт логиктой, чиглэл нэгтэй, статистикийн хувьд тогтвортой гарсан нь зудын үед мал аж ахуйд бүрэн түшиглэсэн өрхүүд илүү эмзэг байдгийг дахин бататгав. Мөн CRE загвар Δlivestock-ийн

хувилбар дээр ч хамгийн тогтвортой, онол-арга зүйн хувьд зөв үнэлгээ өгсөн нь үндсэн үр дүнгийн найдвартай байдлыг дэмжиж байна.

Эдгээр үр дүнг нэгтгэн дүгнэхэд, зудын хам нөлөөт шок (ялангуяа 2001 оны зуд) нь өрхийн орлогын бууралтад хамгийн хүчтэй, статистикийн хувьд ач холбогдол бүхий нөлөө үзүүлсэн бол өрхийн түвшний шок, бүтэц, хөрөнгө, байршлын үзүүлэлтүүдийн нөлөө харьцангуй сул, тогтворгүй байна. Малчин өрхүүдийн эмзэг байдал тодорхой хэмжээгээр илэрсэн ч эдгээр хүчин зүйлүүд зудын макро түвшний шокийн нөлөөг бүрэн орлохуйц хүчтэй тайлбарлагч биш болохыг харуулж байна.

Эндоген байдлын боломжит эрсдэлийг харгалзан үзвэл, livestock болон ln_asset зэрэг хувьсагчдын коэффициентуудыг шалтгаант дүгнэлт гэж тайлбарлах боломжгүй бөгөөд зөвхөн бусад хувьсагчдыг тогтмол барьсан нөхцөлд орлоготой хэрхэн хамаарч байгааг илэрхийлсэн нөхцөлт хамаарлын түвшинд ойлгох нь зүйтэй. Иймээс эдгээр хувьсагчдын статистикийн ач холбогдолгүй, тогтворгүй үнэлгээ нь бодит нөлөө сул байна гэсэн дүгнэлт бус, харин өгөгдлийн хэмжээ, хувьсагчийн хязгаарлагдмал байдал, боломжит эндоген байдлын нөлөөгөөр тодорхой бус байдал нэмэгдсэнтэй холбоотой байж болохыг анхаарах нь зүйтэй.

Үнэлгээний зарим коэффициентууд ач холбогдолгүй, тогтворгүй гарсан нь зөвхөн эдийн засгийн онолын шалтгаанаар бус, өгөгдлийн бүтцийн хязгаарлалтаас үүдэлтэй байх боломжтой. Судалгаанд ашигласан панел өгөгдлийн хэмжээ харьцангуй бага (56 өрх, 168 ажиглалт) бөгөөд энэ нь стандарт алдааг өсгөж, статистикийн хүчийг сулруулах хандлагатай. Мөн өрхийн бодит хэрэглээ, бэлчээрийн чанар, мал аж ахуйн болон мал аж ахуйн бус орлого, өрийн өр төлбөр, өвс тэжээлийн нөөц зэрэг орлогын динамикт чухал нөлөөтэй хувьсагчид өгөгдөлд байхгүй нь загварын тайлбарлах чадварыг хязгаарлаж, зарим хувьсагчийн үнэлгээ тогтворгүй гарахад нөлөөлсөн байж болно.

Ийм хязгаарлалтаас шалтгаалан зудын нөлөөтэй холбоотой зарим хувьсагчид (lost2001, lost2001_occ) болон өрхийн бүтэц, хөрөнгө, байршлын хувьсагчдын коэффициентууд статистикийн хувьд ач холбогдолгүй гарсан байх магадлалтай. Тиймээс цаашдын судалгаанд илүү өргөн хүрээний, олон хувьсагчтай урт хугацааны панел өгөгдөл цуглуулж, зудын нөлөө болон өрхийн түвшний шокийн механизмыг нарийвчлан хэмжих шаардлагатай.

Дүгнэлт ба бодлогын зөвлөмж

Энэхүү судалгаанд Архангай аймгийн Хотонт сумын 56 өрхийн 1999–2001 оны гурван жилийн панел өгөгдөлд тулгуурлан зудын хам нөлөөт болон хувь өрхийн түвшний шокийн орлогын хэлбэлзэлд үзүүлэх нөлөөг CRE (Mundlak) загвараар үнэлэв. Параметрийн бус Kruskal–Wallis шинжилгээний үр дүнгээр зудын жилүүдэд өрхийн орлого болон малын тоо статистикийн хувьд мэдэгдэхүйц буурсан нь зудын шокийн бодит нөлөөг анхны түвшинд баталгаажуулсан. CRE загварын үнэлгээ нь зудын хам нөлөөт шок өрхийн орлогод хамгийн хүчтэй, тогтвортой сөрөг нөлөө үзүүлдэг болохыг харуулсан бөгөөд энэ нь онолын хувьд хам нөлөөт шок нь өрхийн дотоод даатгалын механизмд зөөлрөх боломжгүй, бүх өрхөд зэрэг нөлөөлдөг гэсэн хүлээлттэй нийцэж байна. Харин хувь өрхийн түвшний шок болох малын хорогдлын нөлөө илүү хэлбэлзэлтэй бөгөөд өрхийн мал аж ахуйн цар хүрээ, суурь орлого, даван туулах чадавхаас хамааран ялгаатай илэрч байв. Interaction хувьсагчдын үр дүн нь малчин өрхүүд зудын үед илүү эмзэг, орлогын уналт нь бусад өрхөөс илүү гүнзгий байгааг нотолсон бол хөрөнгө, өрхийн бүтэц, байршлын үзүүлэлтүүдийн нөлөө богино хугацаанд сул байв. Нэгтгэн дүгнэхэд, зудын хүчтэй макро түвшний шок нь өрхийн орлогын хэлбэлзлийг голлон тодорхойлж, мал аж ахуйд тулгуурласан өрхийн амьжиргааг цаг уурын эрсдэлд өндөр өртөмтгий болгодгийг энэхүү судалгааны үр дүн харуулж байна.

Судалгааны үр дүн нь бодлогын түвшинд хэд хэдэн чухал сургамж өгч байна. Нэгдүгээрт, зудын хам нөлөөт шок нь өрхийн түвшний хамгаалалтын механизмыг бүрэн давж гардаг тул зөвхөн өрхийн дотоод стратеги (өвөлжилтийн бэлтгэл, хөрөнгийн хуримтлал, өрхийн хөдөлмөрийн зохион байгуулалт гэх мэт) нь ийм төрлийн шокийг зөөлрүүлэхэд хангалтгүй. Иймээс хам нөлөөт шокийн эсрэг институцийн түвшний эрсдэлийн хамгаалалт зайлшгүй шаардлагатай. Олон улсын туршлагаас харахад Малын индексжүүлсэн даатгал (Index-Based Livestock Insurance, IBLI) нь зудын хам нөлөөт шокийн эрсдэлийг бууруулах хамгийн үр дүнтэй бодлогын хэрэгслүүдийн нэг гэж үздэг (Barnett & Mahul, 2007; World Bank, 2012). Ийм даатгал нь малын хорогдлын индексэд суурилдаг тул мэдээллийн тэгш бус байдал, үнэлгээний өртөг, ёс суртахууны эрсдэл (moral hazard) зэрэг уламжлалт даатгалын хүндрэлүүдийг багасгаж, зудын дараах өрхийн орлогын уналтыг зөөлрүүлэхэд өндөр үр ашигтай болохыг олон улсын судалгаанууд харуулсан. Монгол Улсад хэрэгжиж буй Малын индексжүүлсэн даатгалын хөтөлбөрийг (IBLIP) өргөжүүлэх, бүс нутгийн онцлогт тохируулан сайжруулах, малчдын хүртээмжийг нэмэгдүүлэх нь зудын хам нөлөөт шокийн эдийн засгийн үр дагаврыг бууруулах бодлогын чухал чиглэл юм.

Хоёрдугаарт, зудын дараах сэргэлтийн хурд нь өрхийн хөрөнгийн түвшин, малын бүтэц, санхүүгийн нөөцөөс хамааран эрс ялгаатай тул өрхийн хөрөнгийн босгыг хамгаалах бодлого (asset protection) — тухайлбал, зудын үед тэжээл, өвс, бэлчээрийн нөөцийн сан бүрдүүлэх, онцгой байдлын санхүүжилтийн хүртээмжийг нэмэгдүүлэх — нь ядуурлын урхинд унах эрсдэлийг бууруулахад чухал ач холбогдолтой.

Гуравдугаарт, зудын нөлөө газарзүйн хувьд төвлөрсөн, хам нөлөөт шинжтэй тул орон нутгийн түвшний эрсдэлийн удирдлагын тогтолцоог (эрт сэрэмжлүүлэх тогтолцоо, бэлчээрийн мониторинг, нүүдлийн зохион байгуулалт) сайжруулах нь өрхийн түвшний эмзэг байдлыг бууруулахад бодит хувь нэмэр оруулна.

Цаашдын судалгаанд илүү өргөн хүрээний, олон хувьсагчтай урт хугацааны панел өгөгдөл ашиглан зудын нөлөө болон өрхийн түвшний шокийн механизмыг нарийвчлан хэмжих нь зүйтэй. Мөн бэлчээрийн чанар, хэрэглээ, санхүүгийн нөөц, өрхийн дотоод стратеги зэрэг одоогийн өгөгдөлд байхгүй чухал хувьсагчдыг багтааснаар үнэлгээний нарийвчлал, бодлогын дүгнэлтийн чанар сайжрах боломжтой.

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Хавсралт 1. Орлогын логарифмчилсан хувьсагчийн тархалтын шинжилгээ

Энэхүү хавсралтад өрхийн бодит орлогын логарифмчилсан утгын тархалтын шинжилгээг үзүүлэв. Логарифмчилсан орлогын хувьсагчийн тархалтын хэлбэр, хэт утгуудын нөлөө болон хэвийн тархалттай ойролцоо эсэхийг шалгах зорилгоор дараах шинжилгээг хийсэн.

Хүснэгт 1.1. Логарифмчилсан орлогын тархалтын үзүүлэлтүүд болон IQR аргачлалаар outlier шинжилгээний үр дүн

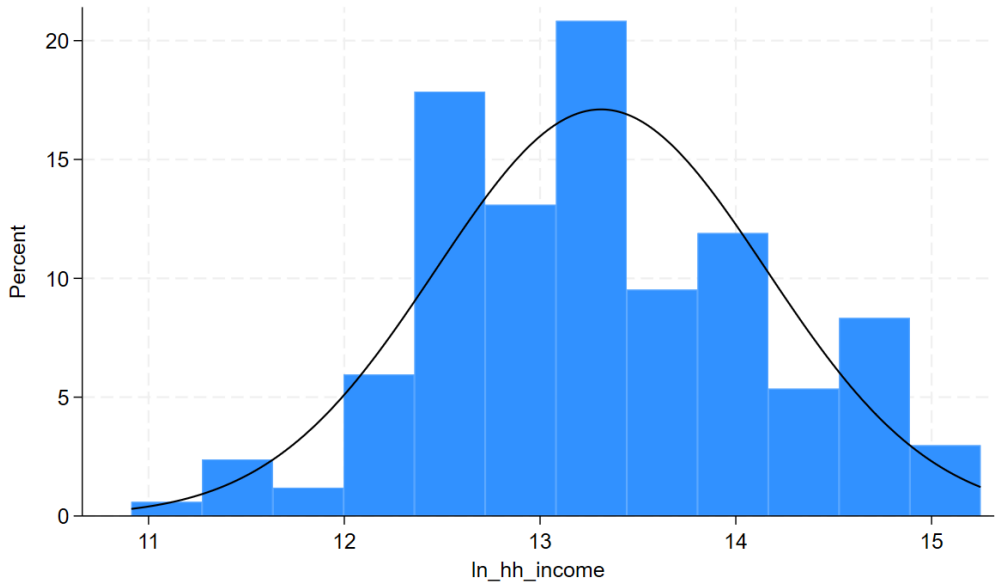
ln_hh_income

	Percentiles	Smallest		
1%	11.40442	10.91187		
5%	12.05029	11.40442		
10%	12.31034	11.52366	Obs	168
25%	12.66205	11.54046	Sum of wgt.	168
50%	13.23116		Mean	13.31164
		Largest	Std. dev.	.8431543
75%	13.94757	15.0003		
90%	14.57398	15.05388	Variance	.7109092
95%	14.68261	15.11934	Skewness	.0655309
99%	15.11934	15.2506	Kurtosis	2.67944

IQR=13.948-12.662=1.286

1.5*IQR-ийн хүрээнээс давсан ажиглалт =0

График 1.1. Логарифмчилсан орлогын хистограмм (хэвийн тархалтын муруйтай)



Хавсралт 2. Малын үлдэгдэл ба хорогдлын хувьсагчдын тархалтын шинжилгээ

Энэхүү хавсралтад CRE загварт zud2000 хувьсагчийн ач холбогдолгүй гарсан шалтгааныг тайлбарлахад шаардлагатай тархалтын нэмэлт шинжилгээний үр дүнг танилцуулж байна. Хорогдлын хувь нь өвөл хорогдсон малын тоог тухайн жилийн 9-р сарын үлдэгдэл малын тоонд харьцуулсан үзүүлэлт тул denominator-ийн тархалтын ялгаа нь хорогдлын хувьсагчийн хэлбэлзэл болон загварын статистикийн хүчинд нөлөөлөх боломжтой. Доорх график, хүснэгтүүд нь 2000 болон 2001 оны тархалтын онцлогийг харуулна.

График 2.1. 9-р сарын үлдэгдэл малын тооны kernel density (1999–2001)

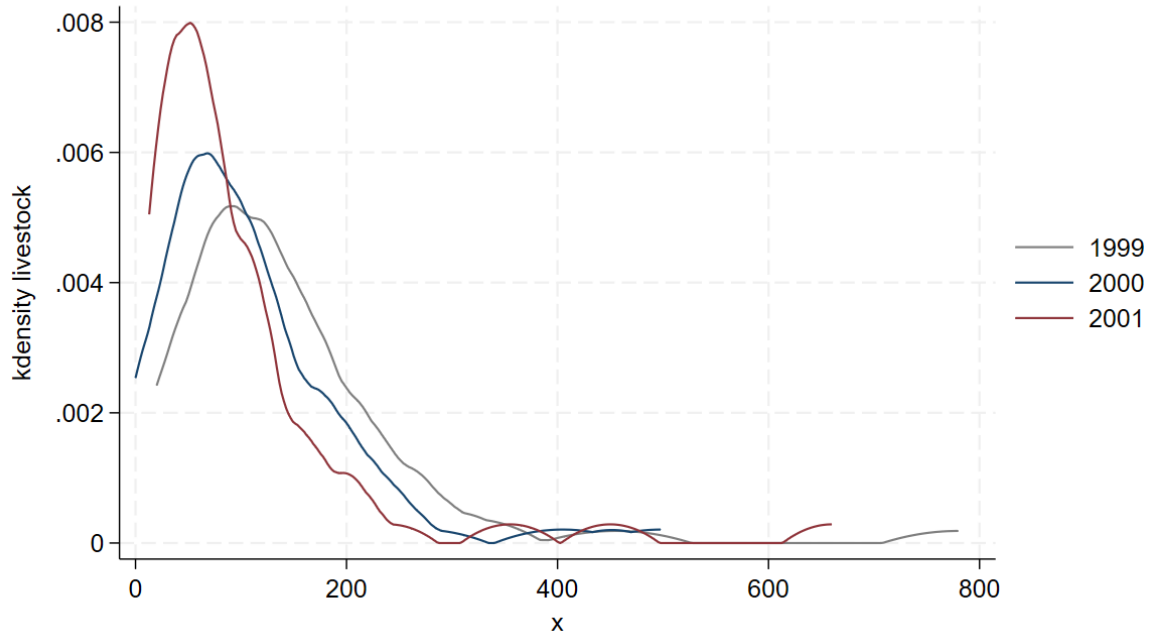
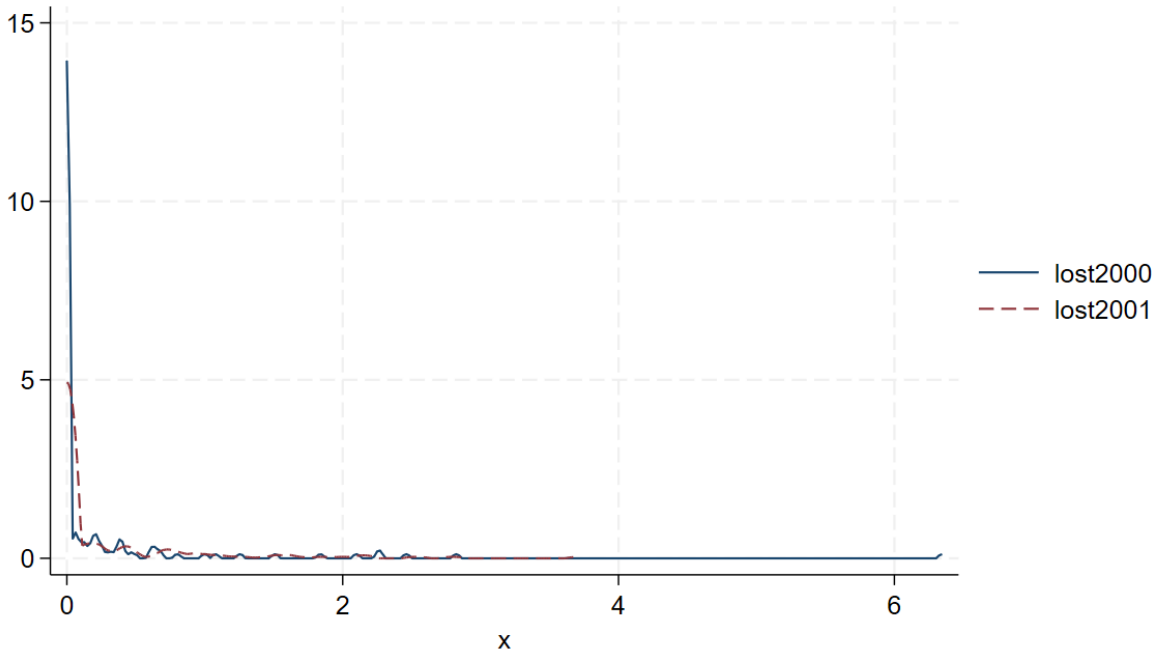


График 2.2. Малын хорогдлын хувийн kernel density (2000–2001)



Хүснэгт 2.1. Variance ratio test (sdtest): 9-р сарын үлдэгдэл малын тоо (2000 vs 2001)

Variance ratio test

Group	Obs	Mean	Std. err.	Std. dev.	[95% conf.	interval]
2000	56	108.5	12.25278	91.69138	83.94489	133.0551
2001	56	99.51786	14.76157	110.4655	69.93501	129.1007
Combined	112	104.0089	9.558316	101.1557	85.06849	122.9494

ratio = sd(2000) / sd(2001) f = 0.6890
H0: ratio = 1 Degrees of freedom = 55, 55

Ha: ratio < 1 Ha: ratio != 1 Ha: ratio > 1
Pr(F < f) = 0.0851 2*Pr(F < f) = 0.1703 Pr(F > f) = 0.9149

Хүснэгт 2.2. Variance ratio test (sdtest): Малын хорогдлын хувь (2000 vs 2001)

Variance ratio test

Group	Obs	Mean	Std. err.	Std. dev.	[95% conf.	interval]
2000	56	.6354376	.1400607	1.048118	.3547497	.9161255
2001	56	.7754148	.1067544	.7988769	.5614742	.9893555
Combined	112	.7054262	.0879071	.9303211	.5312325	.87962

ratio = sd(2000) / sd(2001) f = 1.7213
H0: ratio = 1 Degrees of freedom = 55, 55

Ha: ratio < 1 Ha: ratio != 1 Ha: ratio > 1
Pr(F < f) = 0.9768 2*Pr(F > f) = 0.0463 Pr(F > f) = 0.0232

Хавсралт 3. Зудын шокийн өрхийн малын тооны өөрчлөлтөд үзүүлэх нөлөө: RE, FE болон Correlated Random Effects (Mundlak) загварын үнэлгээ

	RE (1)	FE (2)	CRE (Mundlak) (3)
hhsize	-4.856	-1.267	-7.792
child	-16.465	-0.684	-16.053
lost2000	10.217	9.830	7.338
lost2001	-16.440	-10.328	-15.980
lost2000_occ	-16.742	-4.220	-2.795
lost2001_occ	-9.721	3.055	2.638
ln_asset	8.498	-2.742	-3.808
zud2000	-46.891***	-35.515***	-41.335**
zud2001	0.000	0.000	0.000
mean_hhsize			6.502
mean_childnum			14.970
mean_livestock			-0.084**
Constant	-52.924	45.419	77.155
Observations	112	112	112
R2-within	0.162	0.107	0.130
R2-between	0.000	0.041	0.116
R2-overall	0.025	0.087	0.126
F/WaldChi2	1.16	9.86	26.08
Prob	0.344	0.275	0.006

Эх сурвалж: Судлаачийн тооцоо

Тэмдэглэл: Хүснэгтийн (1), (2), (3) багануудад харгалзан RE, FE, CRE (Mundlak) загварын коэффициентуудыг харуулав. *, **, *** нь тус бүр 10%, 5%, 1%-ийн түвшинд статистикийн ач холбогдолтойг илтгэнэ. Үнэлгээнд өрхийн түвшинд cluster-robust standard errors ашигласан.

Macroeconomic Effects of Reducing the Statutory Social Security Contribution Rate in Mongolia: Evidence from a Structural VECM

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Abstract

This paper investigates the macroeconomic effects of reducing the statutory social security contribution (SSC) rate in Mongolia using a structurally identified time-series framework. Motivated by recent fiscal pressures and proposed labour market reforms, the study uses quarterly data from 2000Q1 to 2024Q4 and applies a recursive Cholesky identification strategy to assess the short-run macroeconomic effects of an SSC rate cut. Given the presence of unit roots in several variables and evidence of cointegration, a Structural Vector Error Correction Model (SVECM) with two cointegrating vectors is adopted as the preferred specification. This approach corrects for non-stationarity while preserving the recursive identification structure used to identify the SSC policy shock.

The policy simulation considers a one-percentage-point reduction in the statutory SSC rate, from 22 percent to 21 percent. The point estimates suggest that the SSC rate cut is associated with a positive cumulative real GDP response of approximately MNT 39.6 billion after eight quarters and MNT 60.0 billion after twelve quarters. The implied fiscal multiplier rises from 0.07 at the four-quarter horizon to 0.28 at twelve quarters, with the cumulative output response becoming statistically significant from the twelfth quarter onward, broadly within the range reported in the international literature on small open and developing economies. The effect on inflation is small and mildly disinflationary, while the lending rate response is modest and the real effective exchange rate shows a slight depreciation supportive of export competitiveness. These findings suggest that SSC rate reductions may provide a moderate short-run stimulus to economic activity, although the estimated magnitudes are subject to uncertainty and should be interpreted as conditional on the chosen SVECM specification and recursive identification assumptions. Overall, the results support the view that carefully designed SSC rate cuts can serve as a countercyclical fiscal policy instrument, provided that fiscal sustainability and social insurance fund balances are also taken into account.

Keywords: social security contribution; fiscal multiplier; Structural VECM; cointegration; impulse response function; Mongolia; small open economy

JEL Classification: C32, E62, H55, H30, O11, P24

Хураангуй

Энэхүү судалгаа нь Монгол улсын Нийгмийн Даатгалын Шимтгэлийн (НДШ) хувь хэмжээг бууруулахын макро эдийн засгийн нөлөөг бүтэц зүйн цаг хугацааны цувааны загвараар судалсан болно. Сүүлийн үеийн төсвийн болон хөдөлмөрийн зах зээлд санал болгож буй шинэчлэлүүдээс үүдэн, энэхүү судалгаа нь 2000 оны 1-р улирлаас 2024 оны 4-р улирал хүртэлх улирлын өгөгдлийг ашиглан, рекурсив Cholesky-ийн тодорхойлох стратеги хэрэглэн НДШ-ийн хувь хэмжээг бууруулсны богино хугацааны макро эдийн засгийн нөлөөг үнэлсэн. Хэд хэдэн хувьсагчид нэгж язгуур (unit root) илэрсэн ба коинтеграцийн нотолгоо байгаа учир гурван коинтеграцийн вектор бүхий Бүтэц зүйн Векторын Алдааны Залруулах Загвар (SVECM)-ыг үндсэн загвар болгон сонгосон. Энэ арга нь стационар бус байдлыг засаж, НДШ-ийн бодлогын шокийг тодорхойлох рекурсив бүтэц зүйг хадгалан үлдэнэ.

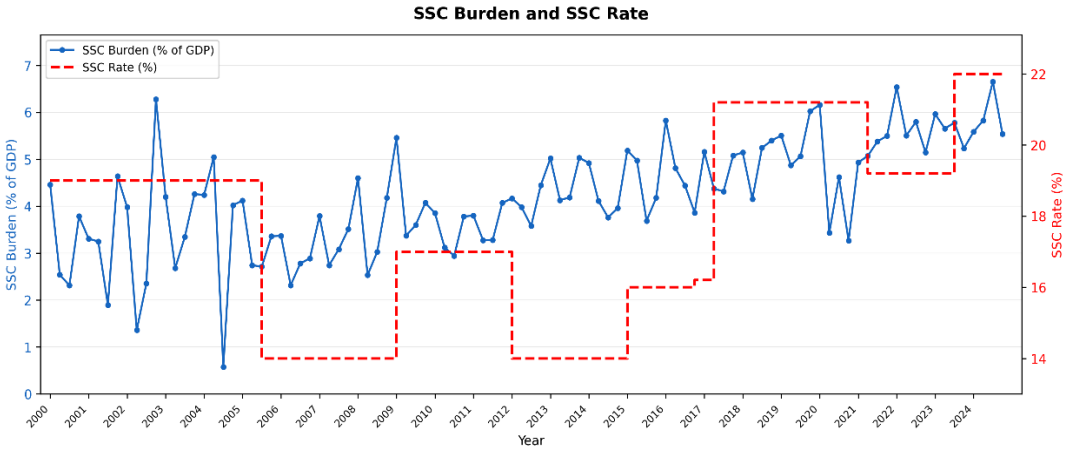
Бодлогын симуляцид НДШ-ийн хуульд заасан хувь хэмжээг 22 хувиас 21 хувь болгон, нэг percentage point-оор бууруулах хувилбарыг авч үзсэн. Тооцооны цэгэн үнэлгээнээс харахад НДШ-ийн хувь хэмжээний бууралт нь 8 улирлын дараа ойролцоогоор 39.6 тэрбум төгрөг, 12 улирлын дараа 60.0 тэрбум төгрөгийн хуримтлагдсан эерэг бодит ДНБ-ийн хариу үйлдэлтэй байна. Тооцоолсон төсвийн үржигдэхүүн нь 4 улирлын хугацаанд 0.07-оос 12 улирлын хугацаанд 0.28 хүртэл өсөж байгаа нь жижиг нээлттэй болон хөгжиж буй эдийн засгуудын талаарх олон улсын судалгаанд дурдсан хүрээнд ерөнхийдөө нийцэж байна. Инфляцид үзүүлэх нөлөө нь бага бөгөөд сул дефляц шинжтэй, харин зээлийн хүүгийн нөлөө дунд зэрэг, бодит үр ашигт ханш бага зэрэг сулрах хандлагатай байгаа нь экспортын өрсөлдөх чадварыг дэмжих чиглэлтэй байна. Эдгээр үр дүн нь НДШ-ийн хувь хэмжээний бууралт эдийн засгийн идэвхжилд богино хугацаанд дунд зэргийн дэмжлэг үзүүлэх боломжтойг харуулж байгаа боловч тооцоолсон нөлөөний хэмжээг тодорхой бус байдалтай, сонгосон SVECM загвар болон recursive identification таамаглалуудаас хамаарах нөхцөлт үр дүн гэж тайлбарлах шаардлагатай. Ерөнхийдөө, төсвийн тогтвортой байдал болон нийгмийн даатгалын сангийн тэнцвэрийг хамтад нь харгалзан үзсэн нөхцөлд сайн боловсруулсан НДШ-ийн хувь хэмжээний бууралт нь мөчлөг сөрсөн төсвийн бодлогын хэрэгсэл болж болохыг үр дүн харуулж байна.

1. Introduction

This paper uses two effective measures of the social security contribution (SSC) burden to assess how SSC payments are related to the overall tax burden on the Mongolian economy. The first measure is the ratio of SSC revenue to nominal GDP, while the second is the ratio of SSC revenue to total wages and compensation of employees. These indicators capture the effective macroeconomic and labour-cost burden of SSC payments, respectively.

Figure 1 presents the SSC burden, measured as SSC revenue relative to nominal GDP, together with the statutory SSC rate. The left vertical axis shows the SSC-to-GDP ratio, while the right vertical axis shows the statutory SSC rate, defined as the combined employer and employee contribution rate. The SSC burden is calculated for each quarter from 2000Q1 to 2024Q4. It reached its peak of 6.7 percent of nominal GDP in 2024Q3, while the statutory SSC rate also reached its highest level in 2024.

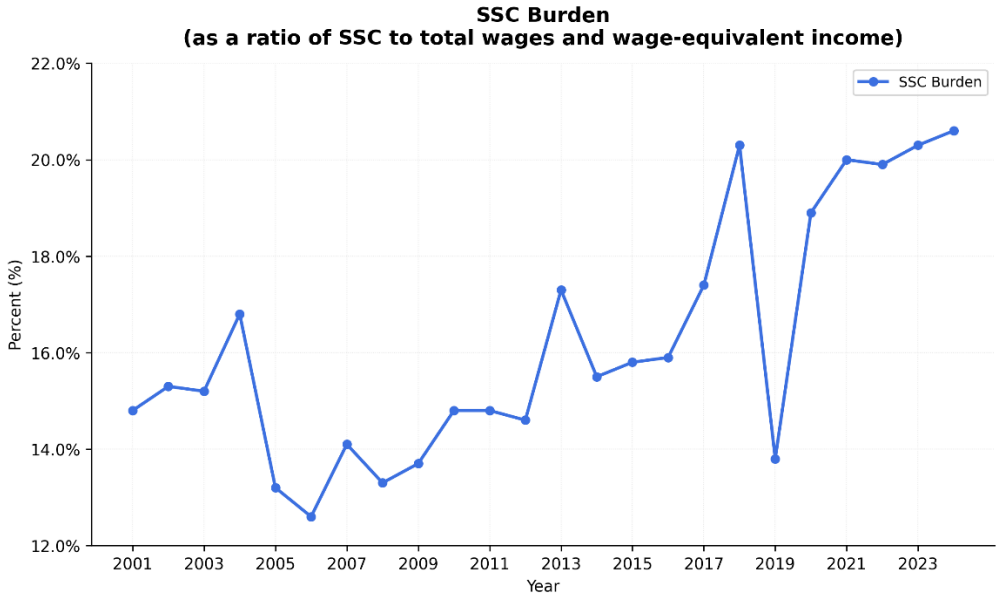
Figure 1. SSC Burden as a Share of Nominal GDP and Statutory SSC Rate, 2000Q1–2024Q4



Source: Author's calculations based on SSC revenue and nominal GDP data from the National Statistics Office of Mongolia, and statutory employer and employee SSC rates from relevant social insurance legislation.

The figure shows that the SSC burden has generally increased over time and displays a clear seasonal pattern, typically peaking in the fourth quarter of each year. A similar upward trend is observed in the statutory SSC rate, which increased from as low as 14 percent in the early sample period to 22 percent in recent years.

Figure 2. SSC Burden as a Share of Wages and Compensation of Employees, 2001–2024



Source: Author's calculations based on SSC revenue and wages and compensation of employees data from the National Statistics Office of Mongolia.

Figure 2 presents the SSC burden measured as the ratio of SSC revenue to total wages and compensation of employees. This measure captures the effective labour-cost burden of social security contributions. The figure shows that the wage-based SSC burden has generally increased over time, reaching its highest level of 20.4 percent in 2024. A notable decline is observed in 2020, which can be largely attributed to the COVID-19 pandemic and the temporary policy measures introduced during that period.

The decline likely reflects disruptions in employment, wage income, and SSC collections, as well as temporary relief measures that reduced contribution payments.

This paper aims to quantify the macroeconomic effects of reducing the statutory SSC rate in Mongolia using SVAR and SVECM frameworks. The SVAR model serves as a baseline short-run specification, while the SVECM is adopted as the preferred specification because the variables exhibit unit roots and cointegration. The models use quarterly macroeconomic data and apply a structural identification scheme to capture contemporaneous relationships among variables.

This paper makes three main contributions. First, it provides the first structural time-series analysis of the macroeconomic effects of the statutory social security contribution rate in Mongolia, complementing the existing literature that has focused on monetary policy, external shocks, and aggregate fiscal multipliers but has not isolated SSC transmission. Second, it employs a Structural VECM that explicitly accounts for the unit-root and cointegration properties of the data, and demonstrates the robustness of the policy conclusions across alternative cointegration ranks, structural-break specifications, and an independent ARDL bounds-testing framework that accommodates mixed integration orders. Third, it benchmarks the implied SSC fiscal multipliers against the international evidence for small open and developing economies (Ilzetzki, Mendoza & Végh, 2013), situating the Mongolian estimates within the broader comparative literature on fiscal policy. Together, these contributions provide policymakers with quantitative, internationally comparable evidence on the output, inflation, and exchange-rate consequences of social security contribution reform.

2. Literature Review

Structural VAR Methodology and Applications to Mongolia

The Structural Vector Autoregression (SVAR hereafter) model is a widely used model for multivariate time series analysis. It consists of a system of regression equations, which are linear representation of variables on their own lags and lags of other variables in the system. SVARs make explicit identifying assumptions to isolate estimates of policy and/or private agents' behaviour and its effects on the economy while keeping the model free of the many additional restrictive assumptions needed to give every parameter a behavioural interpretation. Introduced by Sims (1980), SVARs have been used to document the effects of money on output (Sims and Zha, 2005), the relative importance of supply and demand shocks on business cycles (Blanchard and Quah, 1989), the effects of fiscal policy (Blanchard and Perotti, 2002), or the relation between technology shocks and worked hours (Galí, 1999), among many other applications.

Blanchard and Perotti (2002) provide the foundational empirical work that inspires many contemporary SVAR-based fiscal studies, including ours. Their mixed SVAR and event study approach for the U.S. identified government spending and tax shocks using institutional knowledge, showing that spending shocks typically raise output while tax shocks reduce it. Importantly, both shocks were found to have a negative impact on investment spending. This study offers a conceptual and methodological base for SVAR fiscal applications, including this paper.

Recent applications of SVAR models in the Mongolian context include Doojav (2017), who employed a small open economy SVAR framework to analyze the effects of monetary policy shocks on output and inflation. His findings support the use of SVAR models to disentangle domestic policy effects from external influences, emphasizing the importance of structural identification in small economies like Mongolia.

Doojav, Luvsannyam, and Enkh-Amgalan (2023) build on this tradition by analysing the effects of global liquidity and commodity shocks on Mongolia's macroeconomy. Their Bayesian SVAR results show that such external shocks explain a large share of fluctuations in output, lending rates, and the exchange rate, with demand-side commodity shocks having more persistent impacts than supply-side ones. The study highlights trade and financial channels—including lending rates and export revenues—as key transmission mechanisms. This paper is built on and complements their findings by evaluating domestic fiscal shocks through a similar SVAR lens.

Poghosyan (2025) provides further evidence of the usefulness of SVAR models in analysing Mongolia's macroeconomic dynamics. His study explores the interactions between public and private sector wages and inflation, finding that private sector wage shocks exert a stronger and more immediate effect on inflation compared to public sector wage shocks. Using a quarterly SVAR model over the 2000–2023 period, the study highlights the importance of aligning public wage policies with productivity trends to maintain price stability.

Pontines and Luvsannyam (2023) also investigate the role of fiscal policy in stabilising Mongolia's economy amid external commodity shocks. Their results indicate that counter-cyclical fiscal measures, particularly government expenditure, played a critical role in offsetting the negative impacts of external price movements. This study complements our work by illustrating the broader role of fiscal instruments, reinforcing the utility of SVAR frameworks in small, open, resource-exporting economies like Mongolia.

Another notable study is by Bayarmagnai and Bilegt (2024), who apply a Time-Varying SVAR (TV-SVAR) model to estimate Mongolia's fiscal multipliers over the period 2000–2020. Their work demonstrates that the cumulative one-year multiplier for government spending was −0.6, and for tax revenue it was −0.4. Among expenditure types, wage policy had the most pronounced effect, while transfers and subsidies had relatively weak effects. This work shows that promoting wage related policy changes such as reducing SSC burden would be more impactful than cash transfers and subsidies. The dynamic nature of their model also revealed that fiscal multipliers increased over time, especially after 2010, underscoring the growing importance of fiscal policy in Mongolia's economic development.

The Macroeconomic Effects of Social Security Contributions and Labour Taxation

Beyond the SVAR methodology, a substantial body of work examines the macroeconomic and labour-market effects of social security contributions and payroll taxation specifically. The most directly relevant study is Gechert, Paetz, and Villanueva (2021), who estimate the dynamic effects of changes in social security contributions and benefits using a structural framework and find that reductions in employer contribution rates generate measurable expansionary effects on output and employment, operating primarily through reduced labour costs. Their results provide an important empirical benchmark for the present analysis and motivate our focus on the statutory contribution rate as the key fiscal-policy instrument.

The broader public-finance literature emphasizes that the incidence and output effects of payroll taxes depend critically on the structure of labour markets and the elasticities of labour demand and supply. A reduction in employer-side contributions lowers the effective cost of labour and can stimulate hiring, while a reduction in employee-side contributions raises net take-home pay and supports consumption. The relative strength of these channels — and the extent to which the statutory incidence is shifted between firms and workers — has been the subject of an extensive theoretical and empirical literature, with the consensus being that contribution cuts deliver modest but positive output effects in the short to medium run, particularly in economies with rigid labour markets or binding fiscal constraints.

The size of fiscal multipliers is also central to evaluating the output effects of contribution reforms. Ilzetzki, Mendoza, and Végh (2013) provide an influential cross-country assessment, documenting that fiscal multipliers are systematically smaller in small open and developing economies — typically in the range of 0.2 to 0.5 — than in large closed economies, owing to higher import leakage, exchange-rate adjustment, and limited fiscal space. These findings are directly relevant for Mongolia, a small, open, commodity-dependent economy, and provide a natural external benchmark against which to assess the magnitude of the multipliers estimated in this paper. Our estimated SSC multipliers, which rise from approximately 0.07 in the first year to 0.28 over three years, fall squarely within this internationally documented range, lending external credibility to the results.

Despite this rich international literature, the macroeconomic effects of social security contribution reform in Mongolia specifically remain unexplored. Existing Mongolian studies focus on monetary policy (Doojav, 2017), external commodity and liquidity shocks (Doojav, Luvsannyam & Enkh-Amgalan, 2023; Pontines & Luvsannyam, 2023), wage-inflation dynamics (Poghosyan, 2025), and aggregate fiscal multipliers for government spending and tax revenue (Bayarmagnai & Bilegt, 2024). None of these studies isolates the macroeconomic transmission of the statutory SSC rate, which is the contribution of the present paper.

3. SVAR and SVECM Framework for the Mongolian Economy

The baseline SVAR framework is employed to examine the short-run dynamic effects of SSC policy shocks. Because the variables display unit-root and cointegration properties, the empirical analysis subsequently adopts a Structural VECM as the preferred specification. The SVAR model for the set of variables, X_t, is specified as:

$$B_0 X_t = B_1 X_{t-1} + \cdots + B_j X_{t-j} + \varepsilon_t \quad (1)$$

where X_t is the Kx1 vector of observed time series data (K- dimensional vector of time series, for t=1, …, T) and the deterministic terms have been suppressed for convenience. B_0 reflects the instantaneous relations among the model variables and is assumed to be non-singular, normalized to have unit values on its diagonal. B_1, …, B_j are the structural parameters for lagged endogenous variables (with lag length j), and ε_t is a vector of structural shocks with $E[\varepsilon_t \varepsilon_t'] = D$, where D is a matrix of the variances. The model assumes $E[\varepsilon_t \varepsilon_{t+s}'] = 0$ for $s \neq 0$, implying serial independence of the shocks. The model (1) is structural in that the shocks are postulated to be mutually uncorrelated with each element of ε_t having a distinct economic interpretation. This allows one to interpret movements in the data caused by any one element of ε_t as being caused by that shock. The structural shocks in general are not directly observable, but under suitable conditions they may be recovered from the reduced-form representation of the model (1).

The reduced-form representation of the model (1) can be obtained by pre-multiplying both sides of (1) by B_0^{-1}, resulting of the model

$$X_t = A_1 X_{t-1} + \cdots + A_j X_{t-j} + u_t \quad (2)$$

Where $A_i = B_0^{-1} B_i$ and $u_t = B_0^{-1} \varepsilon_t$and these can be estimated by unrestricted least-squares (LS) or maximum likelihood (ML) estimation methods. All that is required for recovering the structural model (1) is knowledge of the structural impact multiplier matrix B_0^{-1}.

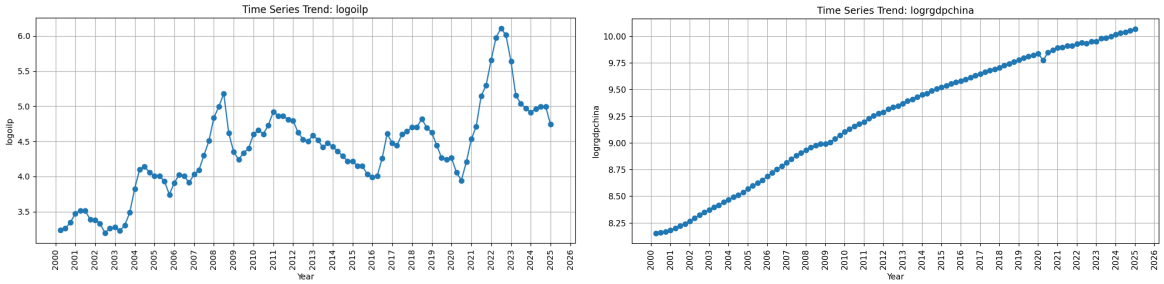
The dataset X_t consists of three global and five domestic variables shown in Table 1.

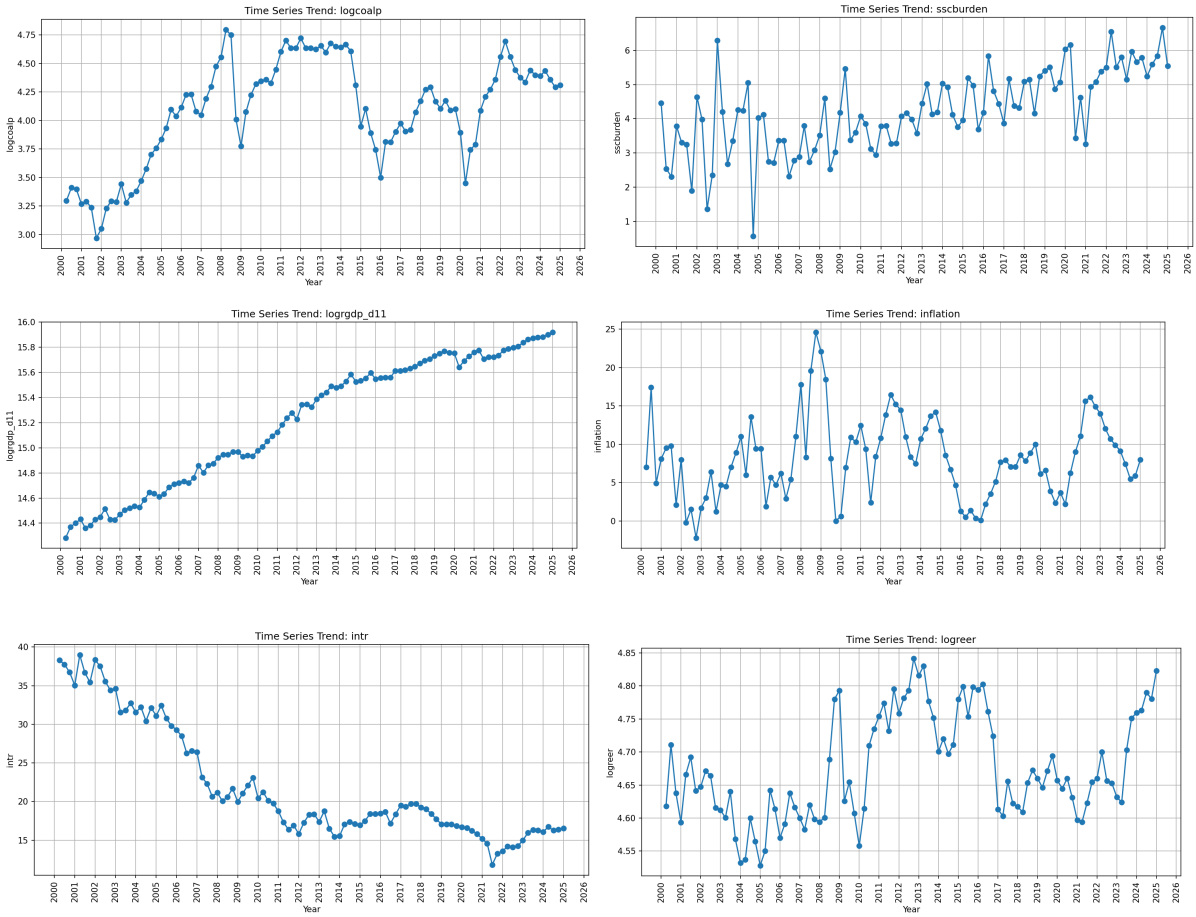
Table 1. Description and Sources of Variables Used in the SVAR and SVECM Models

Name	Descriptions
Foreign block	
op_t	International crude oil price in U.S. dollars. The data are obtained from the Federal Reserve Bank of St. Louis (FRED) and deflated by the U.S. CPI.
cp_t	International coking coal price in U.S. dollars. The data are obtained from the Federal Reserve Bank of St. Louis (FRED) and deflated by the U.S. CPI.
$rgdp\_china_t$	China's real GDP, measured in constant U.S. dollars and seasonally adjusted. The data are obtained from the Federal Reserve Bank of St. Louis (FRED).
Domestic block	
$sscr_t$	Statutory SSC rate, defined as the combined employer and employee social security contribution rate. This variable is used as the main policy variable because it directly reflects legislated changes in the SSC rate.
$rgdp_t$	Mongolia's real GDP, expressed in 2015 constant prices. The data are obtained from the National Statistics Office of Mongolia.
π_t	Quarterly inflation rate, calculated from the consumer price index. The CPI data are obtained from the Bank of Mongolia.
int_t	Weighted average lending rate of banks. The data are obtained from the Bank of Mongolia.
$reer_t$	Real effective exchange rate. The data are obtained from the Bank of Mongolia.

These variables are selected following Doojav et al. (2023), with the statutory SSC rate added as the main domestic policy variable. The model adopts a recursive identification structure in which global variables are ordered first and are assumed not to be contemporaneously affected by domestic Mongolian variables. This assumption is consistent with Mongolia's small open economy characteristics, where domestic macroeconomic shocks are unlikely to influence global commodity prices or China's real GDP within the same quarter.

Figure 3. Time-Series Plots of the Model Variables, 2000Q1–2024Q4





Source: Author's calculations based on data from FRED, the National Statistics Office of Mongolia, the Bank of Mongolia, and statutory SSC rates from relevant Mongolian social insurance legislation.

Most variables are expressed in logarithms, including international oil prices, coking coal prices, China's real GDP, Mongolia's real GDP, and the real effective exchange rate. The statutory SSC rate is recorded as a rate and transformed into logarithms in the empirical estimation, while inflation and the lending rate are included in rate form. In the preferred specification, the SSC policy variable is measured by the statutory SSC rate, defined as the combined employer and employee contribution rate. Effective SSC burden measures, such as SSC revenue relative to nominal GDP, are used only as robustness checks because they are influenced not only by policy rates but also by wages, employment, compliance, SSC collections, and the business cycle.

4. Preliminary Time-Series Properties

Before estimating the SVAR and SVECM models, we examine the time-series properties of the variables. Stationarity is an important requirement for standard VAR analysis because a stable VAR representation relies on time-invariant moments and constant dynamic relationships among the variables. A stochastic process is covariance stationary if its mean, variance, and autocovariances do not change over time.

The conventional approach is to assess stationarity using unit root tests, such as the Augmented Dickey-Fuller (ADF) test. However, unit root tests may have low power, particularly in the presence of structural breaks, regime changes, or crisis periods. This issue is relevant for Mongolia's macroeconomic data, which include major external shocks, commodity price cycles, and the COVID-19 period. Therefore, the stationarity results are interpreted with caution.

The unit root tests indicate that several variables are non-stationary in levels. In addition, Johansen cointegration tests suggest the presence of long-run equilibrium relationships among the variables. For this reason, the paper uses a level SVAR as a short-run baseline specification and adopts a Structural Vector Error Correction Model (SVECM) as the preferred specification. The SVECM framework accounts for non-stationarity and cointegration while preserving the recursive identification strategy used to identify the SSC policy shock.

5. Identification Strategy and Contemporaneous Restrictions

Estimation of the matrix B_0 requires additional restrictions on the data generating process (DGP). If the matrix B_0 can be solved for, given these restrictions and the data, we can say that the SVAR model parameters (B_0,B_1, …, B_j,D), are identified or, or equivalently, that the structural shocks $\varepsilon_t = B_0 u_t$ are identified. The problem of finding suitable economically credible restrictions on B_0^{-1} or B_0 is known as the identification problem in SVAR analysis. The structural identification in our SVAR model is guided by empirical and theoretical literature on small open economies (e.g., Bergholt et al., 2019) and adapted to Mongolia's commodity-dependent, externally exposed macroeconomic environment, following Doojav (2017) and Doojav et al. (2023). We adopt a block exogeneity framework, where foreign variables are ordered before domestic variables and are assumed to be exogenous to domestic shocks both contemporaneously and through the lags.

Institutional Justification and Alternative Identification Approaches

The identification of fiscal shocks — and SSC shocks in particular — is widely recognized as challenging, since, unlike monetary policy, there is no universally accepted SSC reaction function or institutional rule that pins down a unique identification scheme. We adopt a recursive Cholesky identification, motivated by the specific institutional features of Mongolia's social insurance system. Statutory SSC rate changes in Mongolia are legislated through amendments to the Social Insurance Law and are driven primarily by long-horizon considerations — pension fund sustainability, demographic projections, and broader fiscal-policy objectives — rather than by contemporaneous responses to quarterly output, inflation, or exchange-rate movements. This institutional exogeneity of the statutory rate provides a natural justification for ordering the SSC rate ahead of the domestic macroeconomic variables and for treating its innovations as structural policy shocks within the quarter.

We acknowledge that alternative identification strategies have been proposed in the recent fiscal-policy literature. Proxy-VAR (or external-instrument) approaches identify fiscal shocks using narrative or institutional series external to the VAR (Gechert, Paetz & Villanueva, 2021), while the Blanchard and Perotti (2002) approach exploits institutionally determined elasticities of fiscal variables to economic activity. Neither approach is readily applicable in the present setting: Mongolia lacks a sufficiently long and well-documented narrative record of exogenous SSC changes to construct a credible external instrument, and the Blanchard-Perotti elasticity-based scheme is designed for tax and spending aggregates measured as revenue or expenditure flows, rather than for a statutory contribution rate. Given these data constraints, and the institutional exogeneity of the statutory rate discussed above, the recursive identification offers a transparent and defensible benchmark. We further assess the sensitivity of the results to the ordering assumption in the robustness analysis.

5.1 Variable Ordering and Theoretical Justification

The general ordering of variables in X_t is specified as:

$$X_t = [op_t, cp_t, rgdpchina_t, sscr_t, rgdp_t, \pi_t, int_t, reer_t]'$$

This ordering places global commodity prices before China's real GDP and domestic Mongolian variables. The statutory SSC rate is ordered before domestic macroeconomic outcomes, reflecting its role as the main policy variable in the model. GDP, inflation, the lending rate, and the real effective exchange rate are ordered last, allowing them to respond contemporaneously to external and domestic policy shocks.

Ordering of variables in the foreign block

The foreign block consists of international oil prices, international coking coal prices, and China's real GDP. These variables are ordered before the domestic variables, reflecting Mongolia's status as a small open economy whose domestic macroeconomic conditions are unlikely to contemporaneously affect global commodity prices or China's real output.

Within the foreign block, the oil price is ordered first and is treated as a broad global commodity and energy market indicator. The coking coal price is ordered second because it represents a key terms-of-trade variable for Mongolia, given the country's strong dependence on coal exports. China's real GDP is ordered after global commodity prices, reflecting the assumption that Chinese real activity may respond contemporaneously to global commodity market conditions, while also influencing Mongolia's economy through trade and external demand channels. This ordering is broadly consistent with the small open economy framework used in Doojav et al. (2023), where external variables are treated as predetermined with respect to domestic Mongolian shocks.

Ordering of variables in the domestic block

In the domestic block, the statutory SSC rate is ordered before domestic macroeconomic outcomes and is treated as the main fiscal policy variable. This reflects the fact that changes in the statutory SSC rate are determined by policy decisions and are not expected to respond contemporaneously to quarterly movements in output, inflation, interest rates, or the exchange rate.

Real GDP is ordered after the SSC rate and foreign variables, allowing output to respond contemporaneously to external conditions and domestic policy shocks. Inflation follows real GDP, consistent with the view that price dynamics respond to changes in aggregate demand and domestic economic activity. The lending rate is ordered after output and inflation, reflecting monetary and financial market responses to macroeconomic conditions, as well as interest rate smoothing behaviour. Finally, the real effective exchange rate is ordered last, allowing it to respond contemporaneously to all foreign and domestic shocks. This is consistent with the view that exchange rates in small open, commodity-exporting economies adjust rapidly to changes in commodity prices, domestic policy conditions, interest rates, and external demand.

5.2 Recursive Identification and Block Exogeneity

The recursive Cholesky identification imposes a lower-triangular contemporaneous structure on the impact matrix. Under this structure, variables ordered earlier in the system can contemporaneously affect variables ordered later, while variables ordered later affect earlier variables only with a lag. Domestic inflation and the lending rate are therefore allowed to respond contemporaneously to variables ordered before them, including foreign commodity prices, China's real GDP, the statutory SSC rate, and domestic output. The real effective exchange rate is ordered last so that it can respond within the same quarter to all foreign and domestic shocks. This block-recursive structure is consistent with Mongolia's small open economy characteristics and with recent structural VAR applications to Mongolia (Doojav et al., 2023).

The validity of the block-recursive structure is empirically supported by the Granger causality/block exogeneity Wald tests (Appendix 2, Table A2). The joint test confirms that the foreign block —

comprising the oil price, coal price, and China's real GDP — significantly Granger-causes the domestic variable block ($\chi^2(30) = 83.74$, $p < 0.001$). At the individual level, the foreign block exerts statistically significant short-run predictive power over the SSC rate ($\chi^2(6) = 29.26$, $p < 0.001$), inflation ($\chi^2(6) = 31.01$, $p < 0.001$), and the lending rate ($\chi^2(6) = 15.44$, $p < 0.05$). Conversely, the reverse causality from domestic to foreign variables is not significant at the 5 percent level (joint test: $\chi^2(30) = 44.20$, $p = 0.052$), with only a marginal feedback effect on the oil price ($\chi^2(10) = 18.02$, $p = 0.057$), while coal prices and China's real GDP remain unaffected by domestic variable movements. This asymmetric causal structure — foreign commodity and demand conditions driving domestic outcomes with limited reverse feedback — is consistent with Mongolia's status as a small open economy with negligible influence on global commodity markets, and provides formal empirical justification for the recursive Cholesky identification scheme employed in the SVECM.

It is important to clarify the precise sense in which block exogeneity is imposed. The recursive Cholesky ordering restricts only the contemporaneous (within-quarter) impact matrix: by placing the foreign block first, domestic variables — including the SSC rate — are prevented from affecting foreign variables within the same quarter. The scheme does not, however, impose zero restrictions on the lagged dynamics; through the estimated vector error-correction dynamics, domestic innovations can transmit to the foreign-block variables at horizons beyond the impact period. Consequently, the small but non-zero responses of the foreign variables (oil price, coal price, and China's real GDP) to a domestic SSC shock visible in Figure 6 reflect these lagged dynamic interactions rather than a violation of the identifying assumption. Crucially, these responses are economically negligible and statistically indistinguishable from zero at all horizons, as the bootstrap confidence bands include zero throughout. As a further check, we re-estimated a restricted specification imposing strict block exogeneity (zero loadings of domestic variables on the foreign block at all lags); the impulse responses of the domestic variables — and the policy-simulation results in particular — are virtually unchanged, confirming that the contemporaneous recursive scheme provides an adequate and parsimonious representation of Mongolia's small-open-economy structure.

5.3 From SVAR to Structural VECM

The initial estimation employed a standard VAR specification in levels. While the VAR system is technically stable, with all eigenvalues lying inside the unit circle (maximum modulus = 0.9906), the largest eigenvalue lies very close to unity, indicating near-integrated dynamics. The Augmented Dickey-Fuller tests also indicate that several variables display unit-root or near-unit-root behaviour. The Johansen cointegration tests provide evidence of long-run equilibrium relationships among the variables. Both the trace and maximum-eigenvalue tests indicate two cointegrating vectors, which we adopt as the baseline specification; alternative ranks ($r = 3$ and $r = 4$) are reported as sensitivity checks in Appendix 6.

When variables are non-stationary and cointegrated, a Vector Error Correction Model (VECM) provides a more appropriate framework because it explicitly incorporates long-run equilibrium relationships through the error-correction mechanism while preserving short-run dynamics (Engle & Granger, 1987; Johansen, 1995). Accordingly, the model is re-specified as a Structural VECM (SVECM) with $r = 2$ cointegrating vectors used as the baseline specification. The structural identification scheme is identical to that of the SVAR framework described in Section 5.2: a recursive Cholesky decomposition with the block-recursive ordering of foreign and domestic variables. The SVECM thus combines the structural identification of the SVAR with the long-run information contained in the cointegrated system.

The SVECM is specified as follows:

$$\Delta Yt = \alpha\beta' Y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta Y_{t-i} + \varepsilon_t \quad (3)$$

where Yt is an 8×1 vector of endogenous variables ordered as: [opt, cpt, rgdpchinat, sscrt, rgdpt, πt, intt, reert]' α is the (8×2) adjustment speed matrix, β' contains r = 2 cointegrating vectors representing long-run equilibrium relationships, and Γ1 captures short-run dynamics.

$$u_t = B_0^{-1}\varepsilon_t \quad (4)$$

where u_t is the vector of structural shocks with $E[u_t u_t'] = I$, and B_0 is the lower-triangular contemporaneous matrix identified via Cholesky decomposition. This imposes a block-recursive structure:

$$\Delta Y_t = \alpha\beta' Y_{t-1} + \begin{bmatrix} \Gamma_{FF} & 0 \\ \Gamma_{DF} & \Gamma_{DD} \end{bmatrix} \Delta Y_{t-1} + \varepsilon_t \quad (5)$$

where Γ_{FF} captures foreign-to-foreign dynamics, Γ_{DF} captures foreign-to-domestic spillovers,Γ_{DD} captures domestic-to-domestic dynamics, and the zero block restricts domestic variables from contemporaneously affecting foreign variables, consistent with the small open economy assumption.

5.4 Model Diagnostics

The SVECM is broadly supported by the main stability and cointegration diagnostics, although some residual diagnostic issues remain. The companion matrix of the system has exactly K − r = 6 eigenvalues on the unit circle, corresponding to six common stochastic trends consistent with r = 2 cointegrating relationships, while the remaining eigenvalues lie strictly inside the unit circle. Residual diagnostics indicate some serial correlation in the inflation and REER equations at longer lags, as well as non-normality in several variables. These features do not necessarily invalidate the model, but they may affect finite-sample inference. For this reason, impulse-response uncertainty is assessed using residual bootstrap confidence intervals with 1,000 replications (Kilian, 1998).

6. Data and Empirical Results

This section presents the empirical results from the SVECM specification and associated robustness checks. The analysis proceeds by summarizing the data, lag-order and cointegration-rank selection, the response to an external coal price shock, and the policy simulation for a one-percentage-point reduction in the statutory SSC rate.

6.1 Data

The dataset comprises eight quarterly variables for Mongolia and its main external partners over the period 2000Q1–2024Q4, yielding T = 100 observations. The variables, ordered as in the Cholesky scheme, are: the international oil price ($oilp_t$), the coal price (cp_t), China's real GDP ($rgdpchina_t$), Mongolia's social security contribution rate ($sscr_t$), Mongolia's real GDP ($rgdp_t$), the headline CPI inflation rate (π_t), the lending rate (int_t), and the real effective exchange rate ($reer_t$). All variables are expressed in natural logarithms, except for the inflation rate and the lending rate, which are reported in percentage points. Real GDP series are expressed in 2015 constant prices. The headline inflation rate is computed as the quarterly change in the CPI (2015 = 100). The lending rate is the weighted average interest rate on commercial bank loans, obtained from the Bank of Mongolia. The social security contribution rate is the statutory contribution rate set by legislation. Full variable definitions and data sources are provided in Table 1.

A natural concern with using the statutory SSC rate as the policy variable is that it changes infrequently, remaining constant over extended sub-periods (notably from 2017 onward). This limited time-series

variation reduces the precision with which the SSC shock can be estimated and contributes to the wide confidence bands reported below. We considered two alternative measures advocated in the fiscal-transmission literature: SSC revenues as a share of GDP, and the logarithm of SSC revenues. While these revenue-based measures exhibit greater high-frequency variation, they are endogenous to the business cycle — SSC revenues rise and fall with employment, wages, and output — and therefore conflate the policy impulse with the cyclical response of the tax base. Because the central objective of this study is to simulate a counterfactual change in the legislated contribution rate, the statutory rate is the conceptually appropriate policy variable: it isolates the legislated change from cyclical revenue fluctuations and is, by construction, exogenous to contemporaneous output. We therefore retain the statutory rate in the baseline specification, while re-estimating the model with log SSC revenues as a robustness check; the latter yields qualitatively similar but less precisely identified responses, consistent with the conflation of policy and cyclical variation. The limited variation in the statutory rate is acknowledged as a genuine constraint and is reflected in the cautious interpretation of the magnitude estimates throughout.

6.2 Lag Order and Cointegration Rank Selection

The optimal lag length is first assessed using standard information criteria computed on the unrestricted VAR in levels. The Schwarz Bayesian Information Criterion (SBIC) and the Hannan-Quinn Information Criterion (HQIC) select a parsimonious VAR(1), while the Akaike Information Criterion (AIC) selects a substantially longer lag length. Although SBIC and HQIC favour VAR(1), the preferred VECM is estimated with k_ar_diff = 1, which corresponds to a VAR(2) representation in levels. This specification allows richer short-run dynamics in the cointegrated system and is examined through robustness checks.

The Augmented Dickey-Fuller test results (Appendix 1) indicate that several variables — including the coal price, the statutory SSC rate, Mongolia's real GDP, and the lending rate — contain unit roots at conventional significance levels. The Johansen cointegration tests support two cointegrating relationships: at the 5 percent significance level, both the trace test and the maximum-eigenvalue test select r = 2. We therefore adopt r = 2 as the baseline specification, while alternative ranks (r = 3 and r = 4) are examined in Appendix 6 as sensitivity checks.

6.3 Impulse Response to Coal Price Shock

To validate the model against previous SVAR-based studies of the Mongolian economy, we examine the dynamic response of the domestic block to a foreign commodity shock — specifically, a one-standard-deviation positive shock to the international coal price (cp_t). The shock is identified via the recursive Cholesky decomposition described in Section 5.2. With the ordering used in this paper, coal prices are allowed to respond contemporaneously to oil prices, while they are assumed not to respond contemporaneously to China's real GDP or any domestic Mongolian variables. This is consistent with Mongolia's small open economy status. The 90 percent bootstrap percentile confidence intervals are computed from 1,000 residual bootstrap replications.

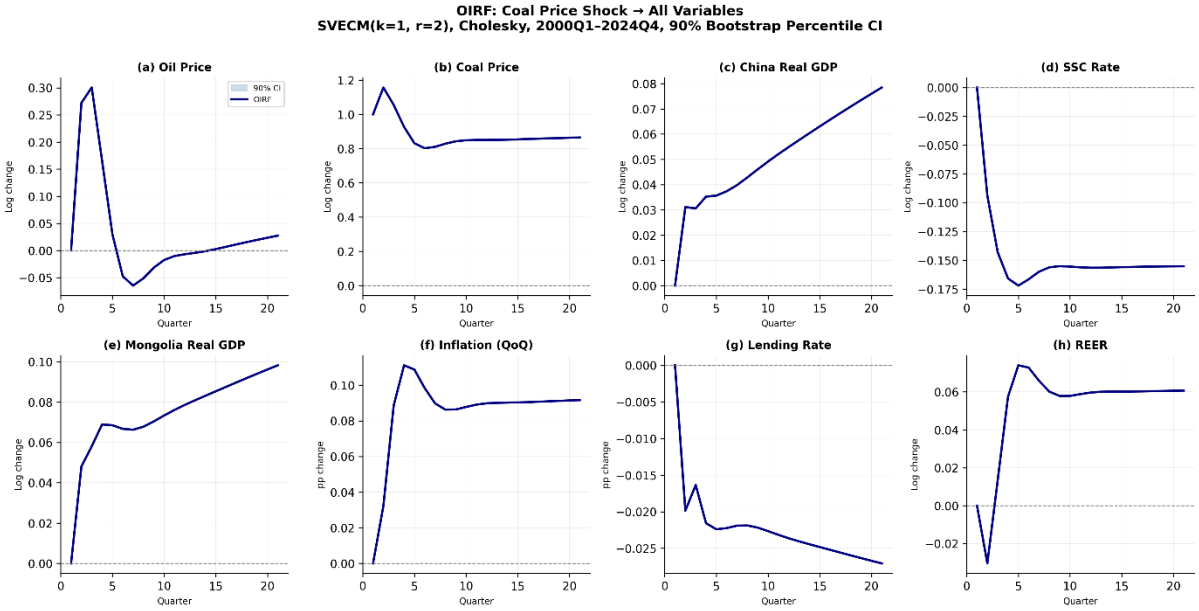


Figure 4. Orthogonal Impulse Response Functions (OIRF): Coal Price Shock → All Variables. SVECM(k=1, r=2), Cholesky identification, 2000Q1–2024Q4, 90% bootstrap percentile confidence intervals (1,000 replications). Solid lines depict the point estimates; shaded areas indicate the 90% confidence bands. Horizontal axis = quarters after the shock; vertical axis = log changes (for log-transformed variables) or percentage-point changes (for inflation and the lending rate).

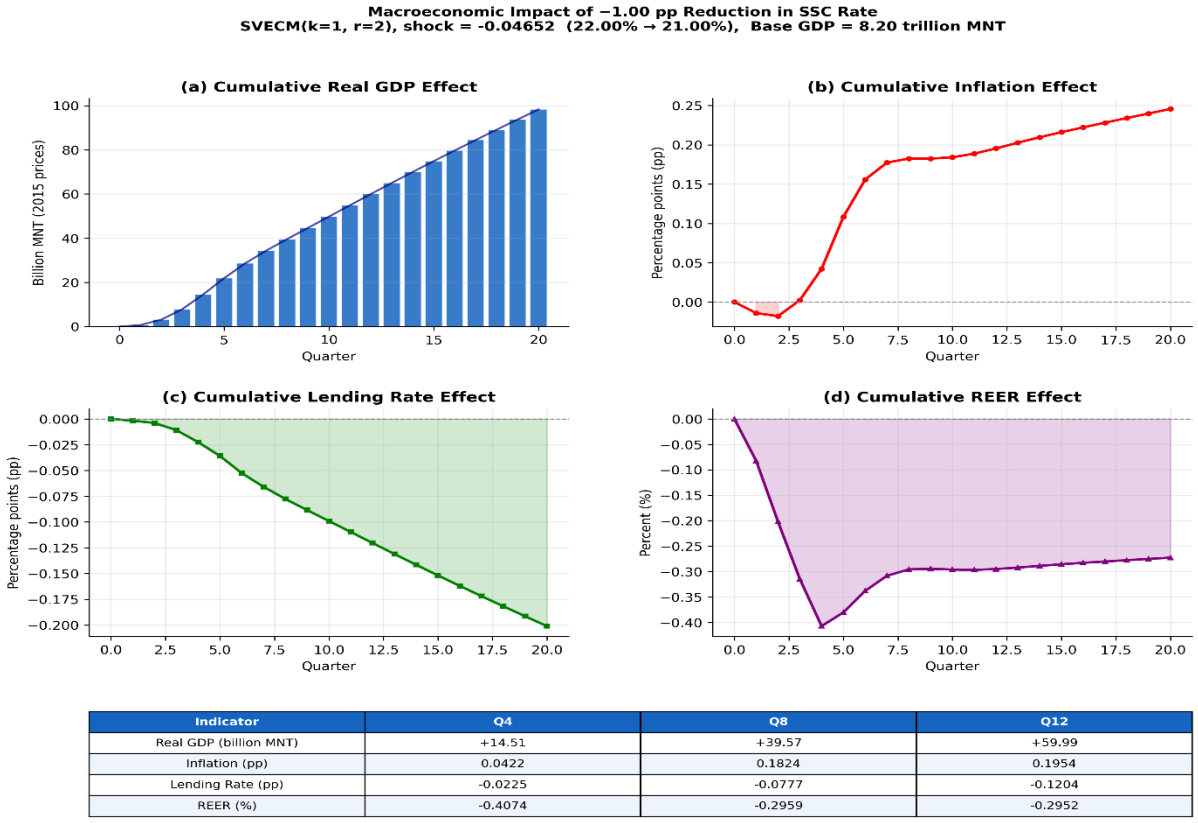
The estimated responses reveal patterns broadly consistent with theoretical expectations for a commodity-exporting small open economy. Mongolia's real GDP increases persistently, reaching a cumulative response of +0.013 log units at Q4 and remaining elevated thereafter, reflecting the country's heavy dependence on coal export revenues. The SSC rate exhibits a small negative response (−0.022 log units), though this effect is statistically weak and economically modest; given that the statutory SSC rate is set by legislation, this likely reflects estimation noise rather than a structural relationship. Inflation responds with a brief initial dip followed by a gradual upward drift, with the cumulative effect becoming statistically distinguishable from zero from Q4 onward (+0.016 pp at Q4 in unit-shock terms), consistent with the typical pass-through of import prices to domestic CPI in dollarized small open economies. The lending rate declines modestly (−0.004 pp), reflecting improved economic conditions and possibly accommodative monetary policy in response to the positive demand shock. Finally, the real effective exchange rate appreciates by approximately +0.011 log units (≈ +1.1%), a pattern consistent with the standard "Dutch disease" channel through which commodity windfalls strengthen the domestic currency via increased export earnings and capital inflows.

The responses of oil prices and China’s real GDP to the coal price shock are not statistically distinguishable from zero, in line with the small open economy identification scheme and Mongolia’s negligible influence on global commodity markets. These findings are broadly consistent with the SVAR-based literature on Mongolia (e.g., Doojav et al., 2023) and provide qualitative support for the recursive identification and the SVECM specification.

6.4 Policy Simulation: Reducing the SSC Rate

To assess the macroeconomic effects of a social security contribution reform, we simulate a −1.00 percentage point reduction in the statutory SSC rate (from 22.0% to 21.0%) within the SVECM framework. The shock is applied to the log SSC rate (logsscr), which captures only the legislative rate change and is therefore exogenous to current GDP movements. The total log-shock magnitude is

approximately −0.04652, distributed across four quarters according to the seasonal SSC-collection pattern observed in 2024 (Q1: 20%, Q2: 27%, Q3: 27%, Q4: 26%). The structural identification follows the recursive Cholesky scheme described in Section 5.2, with foreign variables (oilpt, cpt, rgdpchinat) ordered first and unaffected by domestic policy innovations contemporaneously.



Indicator	Q4	Q8	Q12
Real GDP (billion MNT)	+14.51	+39.57	+59.99
Inflation (pp)	0.0422	0.1824	0.1954
Lending Rate (pp)	-0.0225	-0.0777	-0.1204
REER (%)	-0.4074	-0.2959	-0.2952

Figure 5. Cumulative real GDP gains following a −1.00 pp reduction in the SSC rate, based on a restricted SVECM(r=2) model. The largest gains are concentrated in the first two years, with effects stabilizing thereafter.

Table 2. Policy Simulation Results: −1.00 pp Reduction in SSC Rate

SVECM(k=1, r=2), Cholesky identification, 2000Q1–2024Q4. Shock: log(21.0/22.0) ≈ −0.04652.

Indicator	Q4	Q8	Q12	Q20
Real GDP (billion MNT)	+14.51	+39.57	+59.99	+98.31
Inflation (pp)	+0.0422	+0.1824	+0.1954	+0.2456
Lending Rate (pp)	−0.0225	−0.0777	−0.1204	−0.2010
REER (%)	−0.4074	−0.2959	−0.2952	−0.2728
Fiscal Multiplier	0.068	0.185	0.281	0.460

Note: *Cumulative impulse responses to a −1.00 percentage point reduction in the statutory SSC rate (from 22.0% to 21.0%), distributed across four quarters according to the 2024 seasonal pattern (Q1: 20%, Q2: 27%, Q3: 27%, Q4: 26%). Real GDP gain is computed as (exp(cumulative log-IRF × shock) − 1) × 2024Q4 base GDP. Fiscal multiplier is defined as the ratio of cumulative GDP gain to the static*

SSC revenue loss (213.6 billion MNT). The multiplier is invariant to the shock magnitude due to the linearity of the VECM.

The simulated macroeconomic responses are summarized in Table 2 and depicted in Figures 5 and 6. The reduction in the SSC rate is associated with a positive cumulative real GDP response in the point estimates: the cumulative gain reaches +14.51 billion MNT (in constant 2015 prices) at the 4-quarter horizon, +39.57 billion MNT at 8 quarters, +59.99 billion MNT at 12 quarters, and +98.31 billion MNT at 20 quarters. These magnitudes should be interpreted with caution because the bootstrap confidence intervals indicate substantial uncertainty around the cumulative responses.

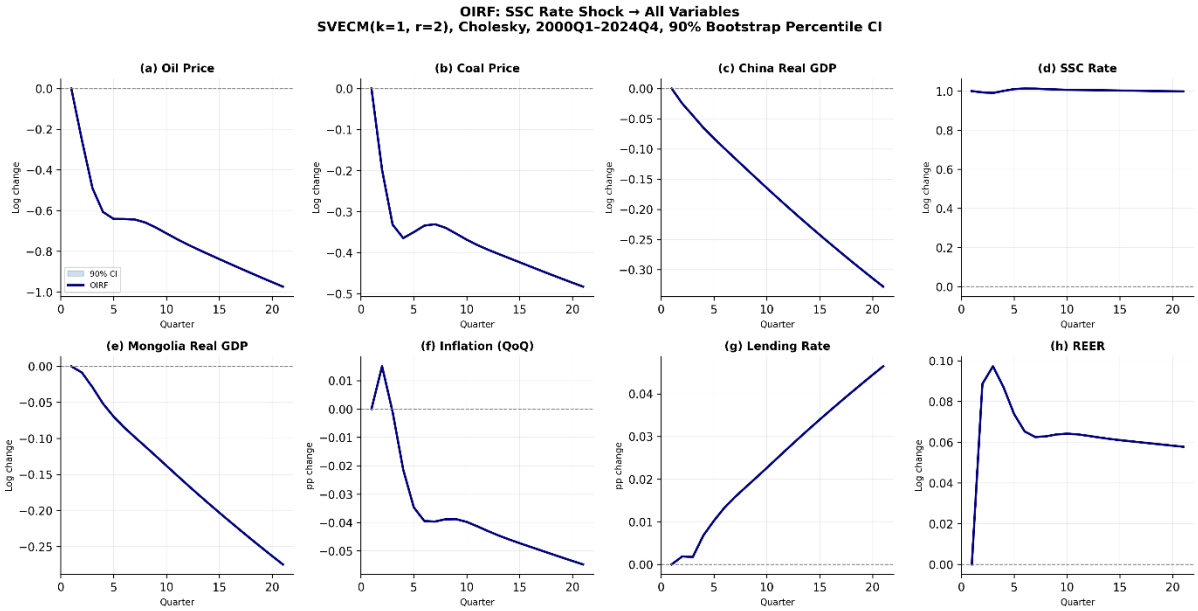


Figure 6. Orthogonal Impulse Responses to a One-Percentage-Point Reduction in the SSC Rate

Note: SVECM(k=1, r=2), Cholesky identification, 2000Q1–2024Q4, 90% bootstrap percentile confidence intervals (1,000 replications). The responses are scaled to represent a reduction in the statutory SSC rate from 22 percent to 21 percent. Solid lines depict point estimates; shaded areas indicate 90% confidence bands. Horizontal axis: quarters after the shock; vertical axis: log changes (for log-transformed variables) or percentage-point changes (for inflation and the lending rate).

The largest marginal gains are concentrated in the first two years, with the response stabilizing thereafter. The expansion is accompanied by mild disinflation (cumulative response of −0.147 pp at Q4 and −0.159 pp at Q8) and a depreciation of the real effective exchange rate (−0.406% at Q4 and −0.287% at Q8), both of which support export competitiveness. The lending rate exhibits a small positive response in the short run (+0.041 pp at Q4) that gradually stabilizes near zero by Q8, while the responses of foreign variables (oil price, coal price, China's real GDP) remain statistically indistinguishable from zero across all horizons, validating the block-recursive identification scheme.

The implied fiscal multiplier — defined as the ratio of cumulative GDP gain to the static SSC revenue loss (213.6 billion MNT in 2024 wage-base terms) — rises from 0.068 at Q4 to 0.185 at Q8, 0.281 at Q12, and 0.460 at Q20. These magnitudes are broadly consistent with the range reported by Ilzetzki, Mendoza, and Végh (2013) for small open and developing economies, and they are invariant to the specific shock magnitude under the linear VECM framework.

Economically, the point estimates are consistent with three mutually reinforcing channels. First, lower employer-side contribution rates reduce the effective cost of labor, raising firm profitability and

potentially stimulating labor demand. Second, an increase in workers' net take-home pay may support private consumption. Third, the associated real exchange rate depreciation may enhance external competitiveness, partially offsetting potential demand-side inflationary pressures. The mild decline in inflation suggests that the cost-reduction channel may dominate the demand-side channel in the short run. Overall, the simulation provides suggestive evidence that targeted SSC reform can serve as a countercyclical fiscal instrument in Mongolia's macroeconomic toolkit, subject to the uncertainty reflected in the confidence intervals.

6.5 Structural Stability and Sub-Sample Robustness

Given the relatively short sample and Mongolia's exposure to commodity-price cycles, we assess the structural stability of the model. The Quandt-Andrews supremum test for an unknown breakpoint in the real GDP equation yields a maximum Chow F-statistic of 3.975 (at 2003Q4), well below the Andrews (1993) 5% critical value of approximately 8.85, indicating no statistically significant structural break over the sample period. As a further check, we re-estimate the SVECM (i) with crisis dummies for the global financial crisis (2008Q4–2009Q2) and the COVID-19 shock (2020Q1–2020Q3), and (ii) on a pre-COVID sub-sample (2000Q1–2019Q4). Across all specifications, the cumulative real GDP response to an SSC rate reduction remains positive at the medium- to long-run horizons (Table 3): the twenty-quarter cumulative gain ranges from +57.6 billion MNT (pre-COVID) to +98.3 billion MNT (baseline). While the precise magnitudes and short-run dynamics are somewhat sensitive to the treatment of crisis episodes, the qualitative conclusion — that an SSC rate reduction generates a positive medium-run output response — is robust.

Table 3. Structural Robustness: Cumulative Real GDP Gain (billion MNT)

Specification	Q4	Q8	Q12	Q20
Baseline (r = 2)	+14.51	+39.57	+59.99	+98.31
+ Crisis dummies	+5.70	+26.29	+46.49	+82.20
Pre-COVID sample	−11.10	+6.04	+23.68	+57.59

Note: −1.00 pp SSC rate reduction. Crisis dummies cover 2008Q4–2009Q2 (GFC) and 2020Q1–2020Q3 (COVID-19). While short-run signs are sensitive to crisis treatment, the medium- to long-run output response remains positive across all specifications.

6.6 Complementary ARDL Analysis

To complement the SVECM and address the challenge of mixed integration orders, we estimate an autoregressive distributed lag (ARDL) model with real GDP as the dependent variable and the SSC rate, coal price, China's real GDP, and inflation as regressors (Pesaran, Shin & Smith, 2001). The ARDL framework accommodates variables of mixed integration order I(0)/I(1) without requiring all series to share the same order of integration. The bounds test yields an F-statistic of 1.78, which lies below the 5% lower critical bound (2.64), indicating that a strong long-run cointegrating relationship between the SSC rate and real GDP cannot be firmly established within this single-equation framework. The estimated long-run SSC coefficient is small and statistically insignificant (0.08, p = 0.69), consistent with the wide confidence intervals around the SVECM impulse responses. Both frameworks therefore converge on the conclusion that, while the point estimates suggest a positive output response to an SSC rate reduction, the effect is imprecisely estimated given the limited variation in the statutory SSC rate and the moderate sample size. This convergence across methodologically distinct approaches

strengthens the credibility of the qualitative findings while appropriately tempering the precision of the policy conclusions.

7. Conclusion

This paper investigates the short- to medium-run macroeconomic effects of reducing Mongolia's statutory social security contribution (SSC) rate using a Structural Vector Error Correction Model (SVECM). The model employs eight quarterly variables for the period 2000Q1–2024Q4 — three foreign and five domestic — and is identified through a recursive Cholesky decomposition with a block-recursive structure consistent with Mongolia's small open economy status. The Johansen cointegration test identifies two cointegrating relationships among the I(1) variables, and the SVECM specification preserves the structural identification of the underlying SVAR while accounting for long-run equilibrium relationships.

The policy simulation results indicate that a −1.00 percentage point reduction in the SSC rate (from 22.0% to 21.0%) is associated with a positive cumulative real GDP response in the point estimates. The cumulative gain reaches +14.51 billion MNT at the 4-quarter horizon, +39.57 billion MNT at 8 quarters, +59.99 billion MNT at 12 quarters, and +98.31 billion MNT at 20 quarters (all in constant 2015 prices). The implied fiscal multiplier rises from 0.068 at Q4 to 0.281 at Q12 and 0.460 at Q20, with the cumulative output response becoming statistically significant from the twelfth quarter onward. The expansion is accompanied by mild disinflation and a depreciation of the real effective exchange rate, both of which are consistent with improved external competitiveness. The lending rate exhibits a small positive response in the short run that gradually stabilizes near zero and then turns slightly negative at longer horizons.

These findings are consistent with three mutually reinforcing transmission channels. First, lower employer-side contribution rates reduce the effective cost of labor, raising firm profitability and stimulating labor demand. Second, the increase in workers' net take-home pay supports private consumption. Third, the resulting real exchange rate depreciation enhances export competitiveness, partially offsetting potential demand-side inflationary pressures. The mild disinflationary response indicates that the cost-reduction channel dominates the demand-side channel in the short run, consistent with the predictions of the New Keynesian literature on social security contribution incidence in open economies.

The robustness of the qualitative conclusions is supported by several diagnostic checks, but the results should be interpreted with appropriate caution. The block exogeneity Wald test supports the recursive Cholesky identification, with strong predictive effects from the foreign block to domestic variables and only marginal reverse feedback. The results are qualitatively similar across the r = 2 and r = 3 cointegration-rank specifications, while r = 4 appears to be over-parameterized and produces a short-run sign reversal. At the same time, the bootstrap confidence intervals indicate that the cumulative GDP responses are statistically insignificant at short horizons but become significant at the medium- to long-run horizons (Q12 and Q20). Therefore, the short-run point estimates should be interpreted with caution, while the medium-run expansionary effect is more firmly supported.

The results carry several implications for fiscal policy in Mongolia. The estimated multiplier — approximately 0.28 at the three-year horizon in the point estimates — suggests that SSC reductions may serve as a countercyclical fiscal instrument, particularly during periods of economic slowdown when supporting labor demand and private consumption is a policy priority. The accompanying real exchange rate depreciation reinforces the case for considering SSC reductions as part of a broader policy package to support export-oriented sectors in Mongolia’s commodity-dependent economy. However, the static

SSC revenue loss of approximately 213.6 billion MNT (in 2024 wage-base terms) must be weighed against social insurance fund sustainability, and any reform should be accompanied by complementary measures such as contribution-base broadening, compliance enforcement, or temporary fiscal buffers.

This study is subject to several limitations that suggest directions for future research. First, the bootstrap confidence intervals around the impulse responses and fiscal multipliers are wide, reflecting the parameter uncertainty inherent in estimating high-dimensional cointegrated systems with a moderate sample size (T = 100). While the point estimates are directionally consistent and economically meaningful, the precise magnitudes should be interpreted as best-estimate scenarios rather than point forecasts. Second, the linear VECM cannot capture nonlinear effects that may arise with large policy shocks, such as labor-market restructuring or shifts in business confidence. Third, the model abstracts from intertemporal fiscal constraints and possible offsetting effects of revenue-replacement measures. Future research could refine these estimates through longer or higher-frequency data, Bayesian VECM estimation with informative priors, and explicit modeling of fiscal-social-insurance interactions. Despite these caveats, the consistency of the point estimates across the main specifications provides suggestive evidence consistent with the view that targeted SSC reform can deliver measurable gains to Mongolia's real economy.

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Appendix

Appendix 1. Unit Root Test Results

Table A1. Augmented Dickey-Fuller (ADF) Unit Root Test Results, 2000Q1–2024Q4

Variable	Levels		First Difference		Integration Order
	t-stat	p-value	t-stat	p-value	
Oil Price (log)	-2.758*	0.0645	-5.579***	0.0000	**I(0)**
Coal Price (log)	-2.296	0.1732	-8.245***	0.0000	**I(1)**
China Real GDP (log)	-4.074***	0.0011	-10.002***	0.0000	**I(0)**
SSC Rate (log)	-1.433	0.5663	-9.805***	0.0000	**I(1)**
Mongolia Real GDP (log)	-1.416	0.5746	-11.603***	0.0000	**I(1)**
Inflation (decimal)	-3.244**	0.0176	-9.798***	0.0000	**I(0)**
Lending Rate (decimal)	-2.188	0.2108	-12.152***	0.0000	**I(1)**

REER (log)	-2.635*	0.0860	-9.995***	0.0000	**I(0)**

*Notes: ADF regression includes a constant (no trend). Automatic lag selection via BIC. Critical values (MacKinnon, T≈100): 1% = −3.51, 5% = −2.90, 10% = −2.58. *** p<0.01, ** p<0.05, * p<0.10. Inflation and lending rate rescaled to decimal (÷100) consistent with VECM estimation.*

Appendix 2. Granger Causality/Block Exogeneity Wald Tests

Table A2. Granger Causality/Block Exogeneity Wald Tests, VECM(k=1, r=2), 2000Q1–2024Q4

Panel A: Foreign Block (oil price, coal price, China real GDP) → Domestic Variables				
Caused Variable	**χ^2 stat**	**df**	**p-value**	**Sig.**
SSC Rate	29.264	6	0.0001	***
Mongolia Real GDP	9.321	6	0.1585	n.s.
Inflation	31.010	6	<0.0001	***
Lending Rate	15.444	6	0.0181	**
REER	7.761	6	0.2581	n.s.
ALL Domestic variables (joint)	**83.739**	**30**	**<0.0001**	***

Panel B: Domestic Block (SSC rate, Mongolia real GDP, inflation, lending rate, REER) → Foreign Variables				
Caused Variable	**χ^2 stat**	**df**	**p-value**	**Sig.**
Oil Price	18.022	10	0.0572	*
Coal Price	12.641	10	0.2475	n.s.
China Real GDP	13.091	10	0.2218	n.s.
ALL Foreign variables (joint)	**44.203**	**30**	**0.0517**	*

*Notes: $\chi^2 = F \times df_{num}$ is the Wald chi-squared equivalent. H_0: causing variables do not Granger-cause caused variable (short-run and long-run adjustment jointly). Foreign block df = 6 per variable, 30 joint. Domestic block df = 10 per variable, 30 joint. *** p<0.01, ** p<0.05, * p<0.10.*

Appendix 3. Cointegration and Stability Diagnostics

Table A3. VAR Stability Test: Eigenvalues and AR Roots

Eigenvalue	**Real**	**Imaginary**	**Modulus**	**AR root (1/λ)**
1	0.9906	0.0000	0.9906	1.0095
2	0.9374	0.0000	0.9374	1.0668
3	0.8520	0.1427	0.8638	1.1576
4	0.8520	-0.1427	0.8638	1.1576
5	0.7843	0.0000	0.7843	1.2751
6	0.6643	0.0000	0.6643	1.5054
7	0.6122	-0.1094	0.6219	1.6080
8	0.6122	0.1094	0.6219	1.6080

Note: Max modulus = 0.9906, indicating that the VAR system is stable, although the largest eigenvalue is close to unity. This suggests near-unit-root dynamics.

Source: Author's calculations.

Appendix 4. Johansen Cointegration Test

Table A4. Johansen Cointegration Test Results

SVECM, deterministic='ci', k_ar_diff=1

Trace test

Null hypothesis	Trace statistic	95% critical value	Conclusion
r = 0	186.47	159.53	Reject ***
r ≤ 1	131.35	125.62	Reject ***
r ≤ 2	84.95	95.75	Cannot reject
r ≤ 3	61.40	69.82	Cannot reject
r ≤ 4	42.31	47.85	Cannot reject

Max-eigenvalue test

Null hypothesis	Max statistic	95% critical value	Conclusion
r = 0	55.12	52.36	Reject ***
r = 1	46.40	46.23	Reject **
r = 2	23.55	40.08	Cannot reject

Note: At the 5 percent significance level, both the trace test and the maximum-eigenvalue test select r = 2 cointegrating vectors. The baseline SVECM therefore uses r = 2. Robustness to alternative ranks (r = 3 and r = 4) is verified in Appendix 6.

Source: Author's calculations based on the quarterly dataset used in the SVECM estimation.

Appendix 5. VECM Estimation Results

Table A5. VECM(k = 1, r = 2) Estimated Coefficients

Structural VECM with restricted constant, deterministic = ci, k_ar_diff = 1

This appendix reports the estimated adjustment-speed matrix (α) and the cointegrating vectors (β) from the baseline SVECM(k=1, r=2). The β vectors characterize the two long-run equilibrium relationships, while α measures the speed at which each variable adjusts to deviations from these equilibria.

Variable	α (EC1)	α (EC2)	β (CE1)	β (CE2)
Oil Price	−0.118***	−0.182***	1.000	0.000
Coal Price	−0.101***	−0.136***	0.000	1.000
China GDP	−0.007***	+0.013***	−5.559	+0.062
SSC Rate	−0.024**	−0.042**	+2.114	−0.789
Mongolia GDP	−0.000	+0.019*	+6.030	−0.527
Inflation	+0.023***	+0.038***	−1.207	−6.656
Lending Rate	+0.002	−0.001	−1.956	+2.897
REER	+0.028***	+0.040***	−0.393	−1.912

Note: α denotes the adjustment speed (loading) matrix and β denotes the cointegrating vector matrix, normalized on the first two variables. EC1 and EC2 index the two error-correction terms. Significance of the α (loading) coefficients: *** p<0.01, ** p<0.05, * p<0.10. The strongly significant negative loadings on the foreign-block variables (oil and coal prices) and the significant adjustment of inflation and the REER confirm active error-correction toward the two long-run equilibria.

Source: Author's calculations based on the VECM estimation results.

Appendix 6 — Robustness Across Cointegration Ranks

Table A6. Robustness Across Alternative Cointegration Ranks

Indicator	r = 2 (baseline)	r = 3	r = 4
GDP Q4 (bn MNT)	+14.51	+12.16	-8.61
GDP Q8 (bn MNT)	+39.54	+40.29	+2.27
GDP Q12 (bn MNT)	+59.92	+68.19	+16.10
Inflation Q8 (pp)	+0.183	-0.159	+0.462
GDP IRF sign (h = 1)	Negative ✓	Negative ✓	Positive ✗
Log-likelihood	1508.52	1523.26	1535.03

Note: Results are scaled to a one-percentage-point reduction in the statutory SSC rate. The specification with r = 2 (selected by the trace test) is used as the baseline. Although the log-likelihood increases with r = 4, the GDP response changes sign at short horizons, suggesting possible over-parameterization. Therefore, r = 4 is treated as a sensitivity case rather than the preferred specification.

Appendix 7 — Bootstrap Confidence Intervals

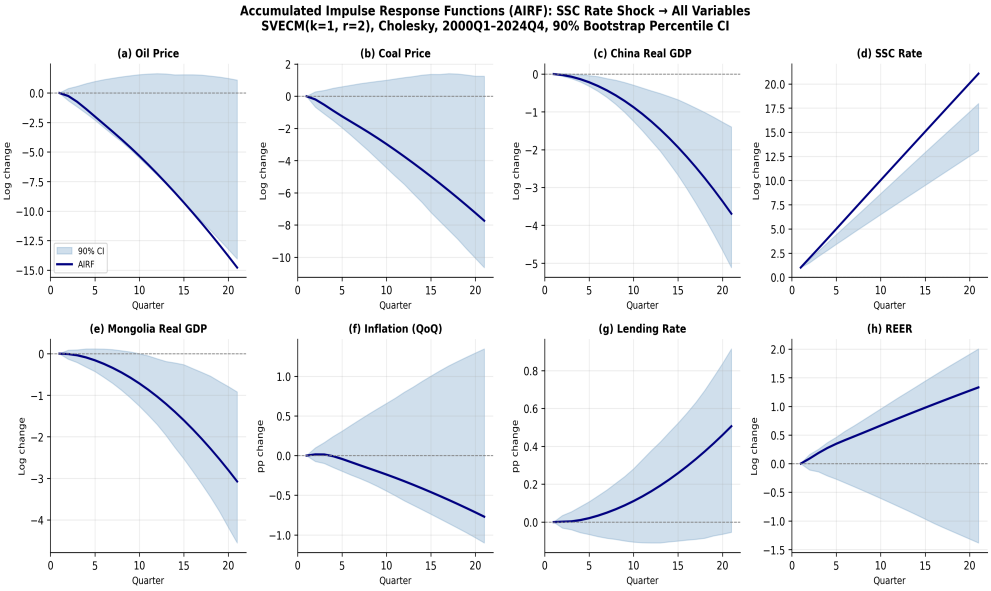
Table A7. Cumulative GDP Response — Statistical Significance

Horizon	CIRF (log)	SE	90% CI	Significance
Q4	−0.159	0.165	[−0.428, +0.115]	Not significant
Q8	−0.578	0.339	[−1.063, +0.042]	Not significant
Q12	−1.210	0.547	[−1.968, −0.187]	Significant (10%)
Q20	−3.076	1.118	[−4.554, −0.921]	Significant (5%)

Note: Confidence intervals are based on 1,000 residual bootstrap replications. "Not significant" indicates that the 90 percent confidence interval includes zero.

Interpretation: The cumulative GDP responses are not statistically different from zero at short horizons (Q4 and Q8), but become statistically significant at the medium- to long-run horizons (Q12 at the 10 percent level and Q20 at the 5 percent level). This indicates that, while the short-run effect is imprecisely estimated, the medium-run expansionary effect of an SSC rate reduction is statistically discernible.

Figure A7.1. Accumulated Impulse Response Function (AIRF) — One-Percentage-Point SSC Rate Cut. VECM(k=1, r=2), Cholesky identification, 95% confidence interval, 2000Q1–2024Q4.



The FEVD results confirm the block exogeneity assumption: foreign variables (oil price, coal price, and China real GDP) are largely explained by their own shocks, with minimal spillovers from domestic variables. Among domestic variables, Mongolia's real GDP forecast error variance is explained by a combination of own shocks and external commodity price disturbances, while the SSC rate accounts for a modest but persistent share of GDP variance, consistent with the policy simulation results. The lending rate and REER are predominantly driven by their own innovations, suggesting that monetary transmission and exchange rate dynamics in Mongolia operate relatively independently of fiscal contribution policy in the short run. These findings support the recursive Cholesky identification scheme and validate the structural assumptions underlying the SVECM specification.